Standard Size, 9 x 12. OCTOBER 15, 1896. Price, Six Cents.

AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

ISSUED WEEKLY BY THE AMERICAN MACHINIST PUB. CO.,

VOL. 19. 256 BROADWAY, NEW YORK. No. 42.

CONTENTS.

PAGE

An English Planing Machine..... 963
Blacksmithing Operations—Working Cold Metal—Drop Forging—Undercut Dies—A Mortised Die—Fatigue of Metals—Rate of Stress and of Recovery—Proper Heats—Heavy Drops. By B. F. Spalding..... 963
Copper Gaskets..... 966
A New Ball Bearing..... 966
The Advantage of the Pneumatic Tire. 966
The Libel on the Crank..... 966
Surgery by Steam Power..... 966
De La Vergne Big Boring Mill—Concluded. By H. L. Arnold..... 967
Some Practical Examples of the Use of Compressed Air in Machine Shops—A Belt Shifter, Center Grinder, Bolt Cutter..... 970
Electrical Machinery: Reversing Motors with Magnetic Brake. By Wm. Baxter, Jr....Planing Machine with Electric Motor.....972, 973
Letters from Practical Men: Corrugated Steam Jackets for Engine Cylinders. By John E. Sweet....Power Tests versus Time Tests. By Tecumseh Swift....Testing Hardness of Metals. By Stephen R. Leonard....Chinese Language and Other Obstacles to Advancement in China. By J. Lansing....A Method of Belt Lacing. By Frank P. Miller....Another Trip for a Foundry Drop. By John Frank....The Economy of Corliss Engine. By F. F. Hemenway....To Bore a Hole, Centered and Square, Through a Cylindrical Piece. By F. J. Woodhurst....Efficiency of Hydraulic Rams. By Charles P. Paulding....Foundations for Machinery. By W. E. Crane....The Elective System and Credit for Shop Experience in Engineering Schools. By Edgar Kidwell....Laying Out Bicycle Sprockets. By W. P. O'Brien....Panel Gage. By Wm. Newton 974-980
An Improved Key-Seating Machine.. 980
Transatlantic Engine Tests. By H. Bollinckx 981
Instruction in Steam Engineering... 981
An Office Building Supplied with Compressed Air..... 981
Back Pressure in Single and Multiple Expansion Engines..... 982
Power Tests of Machine Tools..... 982
Questions and Answers..... 982
State Organization of the National Association of Stationary Engineers in Massachusetts..... 983
Commercial Review..... 984

Index to Articles Advertised, Pages 10 to 13.
Index to Advertisers, Page 9.

H. Bollinckx,
95 Chaussée de Mons,
Brussels, Belgium,

Offers for sale his American patent for steam engines.

He proposes to grant licenses for their manufacture in America upon favorable terms.

For the further sum of $2,000 he will supply complete working drawings for engines of the following sizes:

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	
Diam. of Cyl.	40	45	50	60	75	centimeters
	14.75	17.75	19.68	23.62	29.53	inches
Stroke, ...	80	90	100	120	150	centimeters
	31.5	35.43	39.37	47.24	59.05	inches

As shown in this paper, March 12, these engines give very remarkable results in steam economy.

Further particulars regarding them are given by Prof. Sweet, in issue of August 6.

Elsewhere in the present number will be found an article replying to comments by Harris Tabor.

Correspondence solicited. Address as above.

The Elliott Drill Press.

For any light work. Large Range. Low Prices. Ask for Catalogue.

Now Manufactured by

A. J. WILKINSON & CO.

180-188 Washington Street,
BOSTON, MASS.

Machinists' Fine Tools
STANDARD TOOL CO., ATHOL. MASS.
SEND FOR NEW CATALOGUE

SENT FREE

Catalogue containing all the latest and most important books on Steam, the Steam Engine, Mechanics, Machinery, Mechanical and Electrical Engineering.

PHILADELPHIA BOOK COMPANY,
Practical and Scientific Books,
19 South Ninth Street, PHILADELPHIA, PA.

The Toledo Machine and Tool Co.
Oak and Jackson Ave.
TOLEDO, OHIO, U. S. A.
MAKERS OF
PRESSES, SPECIAL MACHINERY,
and machines for the manufacture of
Bicycles, Drop Forgings
Stampings, Brazed Tubing,
and a general line of sheet metal work.
SEND FOR CATALOGUE "A."

MOFFET PORTABLE DRILL.

UNSURPASSED AS A REAMER.

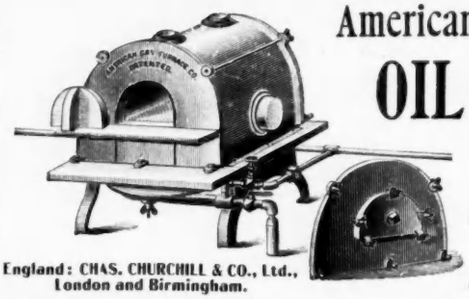
Will work in any position.

Weighs 48 lbs. and drills from ⅛ to 2¼ inches diameter.

RUNS WITH STEAM —OR— COMPRESSED AIR.

Send for Circular.

Manufactured by
J. G. TIMOLAT,
465-467 W. Broadway,
NEW YORK.



American Gas Furnace Co.

OIL GAS PLANTS

GAS BLAST FURNACES and HIGH PRESSURE BLOWERS.

For the economical generation and systematic application of heat.

England: CHAS. CHURCHILL & CO., Ltd., London and Birmingham.

80 Nassau Street, NEW YORK.

R. Mushet's

SPECIAL AND TITANIC STEELS.

THE STANDARD OF EXCELLENCE.

B. M. JONES & Co.
BOSTON and NEW YORK.

UNIVERSAL AND PLAIN GRINDING MACHINES

IN THE FOLLOWING SIZES:

No. 1	Swings 8 in.,	takes 30 in.	between centers.	No. 4	Swings 12 in.,	takes 66 in.	between centers.				
" 2	" 8 "	" 30 "	" "	" 4A	" 16 "	" 66 "	" "				
" 3	" 12 "	" 42 "	" "	" 5	" 20 "	" 96 "	" "				
" 3A	" 16 "	" 42 "	" "	" 6	" 20 "	" 144 "	" "				

Send for full particulars to **Landis Bros., Mfrs., Waynesboro, Pa., U.S.A.**

AGENTS— ENGLAND, CHAS. CHURCHILL & CO., Ltd., London and Birmingham.
FRANCE, AD. JANSSENS, 16 Place de la Republique, Paris.
GERMANY, SCHUCHARDT & SCHUTTE, 59 Spandauerstrasse, Berlin.
AUSTRIA, " " " 17 Breitgasse, Vienna.

FINE TAPS

OF EVERY DESCRIPTION.

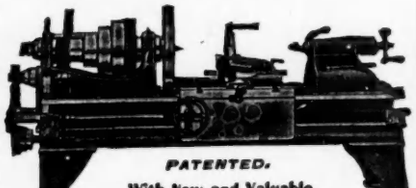
Manufactured by WELLS BROS. & CO., Greenfield, Mass., U. S. A.

FILES RECUT BY HAND.

Hand Cut Files are best and cheapest in the end. : : :
We sell direct to users; write for new price list. : : :

REYNOLDS BROTHERS,
145 to 149 W. Spring St.,
COLUMBUS, OHIO, U. S. A.

HIGH CLASS ENGINE LATHES.

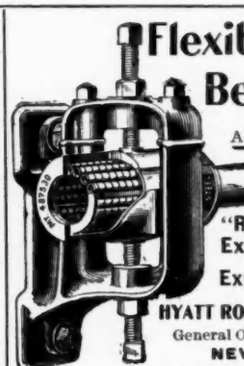


PATENTED.
With New and Valuable Features.

MADE ONLY BY
THE BRADFORD MILL COMPANY,
Catalogue "A" describes our Lathes, sent on application. **CINCINNATI, OHIO, U. S. A.**
ENGLAND—Chas. Churchill & Co., Ltd., London & Birmingham.
NEW YORK—Garvin Machine Co., Spring and Varick Sts.

Flexible Roller Bearings

ARE SUPERIOR.



A FACT WHICH
"Reason Perceives, Experiment Verifies AND Experience Confirms"

HYATT ROLLER BEARING CO.,
General Office, 450 Market St.,
NEWARK, N. J.
New York Office, 26 Cortlandt St.

DO YOUR THRUST COLLARS HEAT?

Why not Save Trouble, Time and Oil
BY USING

HUB BALL BEARINGS?

Cheap. Durable. Effective.

For All Sizes of Shaft.
Write for Circular and Price List.

THE BALL BEARING CO.,
10 Watson St., BOSTON, Mass.

Index to Advertisers.

	PAGE
Abbott, Wheelock & Co.	13
Acme Machinery Co.	14
Adt & Son, John	6
Albro-Clem Elevator Co.	6
Almond, T. R.	8
American Gas Furnace Co.	2
Ames Iron Works	46
Arcade File Works.	14
Armstrong Mfg. Co.	45
Audel, Theo.	9
Aurora Tool Works	6
Baird & Co., Henry Carey	41
Baker Bros.	41
Ball-Bearing Co., The	2
Barker & Co., William	8
Barnes Co., W. F. & John	8
Bates, Henry H.	41
Besly & Co., Chas. H.	41
Bethlehem Foundry and Machine Co.	9
Bickford Drill and Tool Co.	43
Bickford, H.	48
Bilgram, Hugo	9
Blaisdell & Co., P.	47
Bliss Co., E. W.	7
Boston Gear Works	46
Box 62	13
Bradford Mill Co., The	2
Bradley Co., The	39
Brainard Milling Machine Co.	6
Bremer Machine Co., Godfrey J.	6
Brown & Sharpe Mfg. Co.	48
Buffalo Forge Co.	47
Builders Iron Foundry	4
Bullard Machine Tool Co.	40
Central Packing Works	13
Cincinnati Milling Machine Co.	41
Cleveland Machine Screw Co.	48
Cleveland Twist Drill Co.	43
Clough, R. M.	45
Coburn Trolley Track Mfg. Co., The	13
Coffin & Leighton	13
Columbia University	40
Compressed Air	43
Conover Mfg. Co.	41
Crescent Steel Co.	43
Crocker-Wheeler Electric Co.	4
Cumberland Iron & Steel Shafting Co.	7
Curtis & Curtis	37
Cushman Chuck Co.	3
Dallett & Co., Thos. H.	4
Davis & Egan Mach. Tool Co	45
Deane Steam Pump Co.	14
Detrick & Harvey Machine Co.	47
Diamond Machine Co.	41
Dietz, Schumacher & Boye	47
Dixon Crucible Co., Joseph	45
Dwight Slate Machine Co.	11
Dyer & Driscoll	39
Egan Co., The	3
Elliott Chemical Works	4
Erlandsen, J.	6
Evans Friction Cone Co	46
Ferracute Machine Co.	6
Fifield Tool Co.	48
Fitchburg Machine Works	43
Flather & Co.	47
Fogarty Co.	37
Forbes & Co., W. D.	45
Fox Machine Co.	7
Frasse Co., The	37
Frick Co., The	46
Garvin Machine Co., The	8 and 13
General Electric Co.	3
Gisholt Machine Co.	45
Goodyear, S. W.	4
Gould & Eberhardt	14
Grant Gear Works	9
Gray Co., G. A.	14
Greenfield, W. G. & G.	46
Guild & Garrison	4
Hamilton Machine Tool Co.	4
Hampden Corundum Wheel Co.	3
Harrington & King Perforating Co.	48
Hartford Steam Boiler and Ins. Co.	40
Hendey Machine Co.	38
Henley & Co., N. W.	37
Hill, Clarke & Co.	11
Hoggson & Pettis Mfg. Co.	3
Hoppes Mfg. Co., The	6
Horton & Son Co., E.	3
Hurlbut-Rogers Machine Co	47
Hyatt Roller Bearing Co.	2
Ingersoll-Sergeant Drill Co.	40
International Correspondence Schools	6
Jenkins Bros.	39
Johns Mfg. Co., H. W.	47
Jones & Co., B. M.	2
Jones & Lamson Machine Co.	14 and 48
Kempsmith Machine Tool Co.	47
Keuffel & Esser Co.	8
Keystone Engine and Machine Works	46
King Mfg. Co.	3
Landis Bros.	2
Le Blond, R. K.	3
LeCount, Wm. G.	3
Lodge & Shipley Machine Tool Co	7
Long & Allstatter Co.	3
Maris Bros.	47
McCabe, J. J.	8
McFadden Co.	9
Mewer Tool Co.	8
Miner & Peck Mfg. Co.	9
Monighan Machine Works	8
Montgomery & Co	9
Morse Twist Drill & Machine Co.	4
Mossberg & Granville Mfg. Co.	41
National Chuck Co.	3
National Machinery Co.	6
National Pipe Bending Co.	43
Newark Machine Tool Co.	13
New Haven Mfg. Co.	11
Nicholson File Co.	14
Niles Tool Works Co.	14
Niles Tool Works Co., N. Y. Branch	8
Norton Emery Wheel Co.	39
Oneida Mfg. Chuck Co.	3
Ott, Mergenthaler & Co	8
Otto Gas Engine Works	40
Pancoast Ventilator Co	3
Patterson, Gottfried & Hunter	6
Penberthy Injector Co.	8
Philadelphia Book Co.	2
Pierce Engine Co	40
Pond Machine Tool Co	48
Pratt & Whitney Co.	39
Pratt Chuck Co.	5
Prentiss Tool & Supply Co.	43
Pryibil, P.	12
Q. and C. Co.	43
Rand Drill Co.	45
Reece, Edw. J.	8
Reed Co., F. E.	41
Reinecker, J. E.	40
Reynolds Bros.	2
Roots, P. H & F. M.	47
Sackmann, F. A.	12
Saunders' Sons, D.	4
Sawyer Tool Co	8
Sebastian Lathe Co.	70
Sellers & Co., Inc., Wm.	14
Seneca Falls Mfg. Co.	39
Shriver & Co., T.	43
Sibley & Ware	12
Skinner Chuck Co	3
Slocomb & Co., J. T.	11
Smith, E. G.	11
"Specialty"	13
Springfield Gas Engine Co., The	40
Standard Tool Co.	2
Stark, John	43
Stiles & Fladd Press Co., The	7
Sterling Emery Wheel Mfg. Co.	43
Strelinger & Co., Chas. A.	12
Sturtevant Co., B. F.	47
Stuart's Foundry & Machine Works, R. J.	48
Taunton Locomotive Mfg. Co.	43
Timolat, J. G.	2
Toledo Machine & Tool Co.	2
Toomey Frank	8
Torrington Mfg. Co.	4
Trump Bros. Machine Co.	13
Vitrified Wheel Co.	7
Warner & Swasey	48
Waterbury-Farrel F'dry & Mach. Co.	47
Waterbury Machine Co., The	3
Watson-Stillman Co., The	10
Webster Mfg. Co	40
Webster & Perks Tool Co.	41
Wedderburn & Co., John	48
Wells Bros. & Co.	2
Welis, Heber	40
Weston Engine Co.	40
Wetherill Machine Co., James P.	40
Whitcomb Mfg. Co.	3
Whiton Machine Co., D. E.	3
Wiley & Sons, John	39
Wiley & Russell Mfg. Co.	39
Wilkinson & Co., A. J.	2
Wilson, W. A.	11
Woodward & Rogers	45
Worcester Machine Screw Co.	37
Wyke & Co., J.	13
Wyman & Gordon	48

GRANT GEARS

GRANT GEAR WORKS.

Gear Wheels and Gear Cutting. Ready-made Gears.

Treatise, $1.00. Catalog free.

THREE FULLY EQUIPPED SHOPS.

BOSTON, 6 Portland Street.

PHILADELPHIA, 125 South Eleventh St.

CLEVELAND, 86 Seneca Street.

BETHLEHEM ROTARY SHEAR

Will cut Sheet Metal and Plates ¼ inch thick or less, in circles, curves or straight-away, any length, any width up to 31 inches.

BETHLEHEM FOUNDRY AND MACHINE COMPANY, South Bethlehem, Pa.

BEVEL GEARS

Cut Theoretically Correct. Special facilities for cutting worm wheels.

HUGO BILGRAM, Machinist, 440 N. 12th St., Phila., Pa.

McFADDEN COMPANY.

TAPS & DIES · VISES · DRILLS · CHUCKS · TWIST · MACHINE · SCREWS · LATHES · FILES · STEEL · TOOLS · STUBS

TOOLS

No. 722 Arch St., PHILADELPHIA, PA.

Montgomery & Co
Have Everything
a Machinist requires.
Our address is
105 Fulton St.
New York City

Robert Files

Hawkins' "Aids" to Engineers

EXAMINATIONS, with Questions and Answers, 5½x7½, leather, gilt edge, $2, postpaid. Send for Descriptive Catalogue of this and other Engineers' Books. THEO. AUDEL & CO., 63 Fifth Ave., cor. 13th Street, N. Y.

For Sale Cheap.

• • •

400-lb. Merrill Friction Drop Hammer in first-class condition.

MINER & PECK MFG. CO.

Box 424, New Haven, Conn.

Buyers' Finding List.

ADDING MACHINES.
Grant Calculating Machine Co., Boston, Mass.

AIR COMPRESSORS.
Guild & Garrison, Brooklyn, N. Y.
Ingersoll-Sergeant Drill Co., New York.
Rand Drill Co., New York.

ASBESTOS CEMENT FELTING.
Johns Mfg. Co., H. W., New York.

BALLS, STEEL.
Cleveland Machine Screw Co., Cleveland, O.

BEARINGS, ANTI-FRICTION.
Ball Bearing Co., The, Boston, Mass.
Hyatt Roller Bearing Co., Newark, N. J.
Mossberg & Granville Mfg. Co., Attleboro, Mass.

BELT DRESSING.
Dixon Crucible Co., Joseph, Jersey City, N. J.

BICYCLE TOOLS.
American Gas Furnace Co., New York.
Bickford Drill & Tool Co., Cincinnati, O.
Bliss Co., E. W., Brooklyn, N. Y.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cleveland Mach. Screw Co., Cleveland, O.
Davis & Egan Mach. Tool Co., Cincinnati, O.
Ferracute Machine Co., Bridgeton, N. J.
Garvin Machine Co., New York.
Hill, Clarke & Co., Boston, Mass.
Lodge & Shipley Machine Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Mossberg & Granville Mfg. Co., Attleboro, Mass.
Niles Tool Works Co., Hamilton, O.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Woodward & Rogers, Hartford, Conn.

BLOWERS.
American Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
Cooke & Co., New York.
Roots, P. H. & F. M., Connersville, Ind.
Sturtevant Co., B. F., Boston, Mass.

BOILERS, STEAM.
Greenfield, W. G. & G., East Newark, N. J.
Weston Engine Co., Painted Post, N. Y
Wetherill Mach. Co., James P., Chester, Pa.

BOLT CUTTERS.
Acme Machinery Co., Cleveland, O.
Davis & Egan Machine Tool Co., Cincinnati, O.
Detrick & Harvey Machine Co., Baltimore, Md.
Hill, Clarke & Co., Boston, Mass.
National Machinery Co., Tiffin, O.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reece, Edw. J., Greenfield, Mass.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Strelinger & Co., Chas. A., Detroit, Mich.
Webster & Perks Tool Co., Springfield, O.
Wells Bros. & Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

BOOKS.
Audel & Co., Theo., New York.
Baird & Co., Henry Carey, Philadelphia, Pa.
Grant Gear Works, Boston, Mass.
Henley & Co., Norman W., New York.
Newark Machine Tool Co., Newark, N. J.
Philadelphia Book Co., Philadelphia, Pa.
Practical Publishing Co., East Orange, N. J.
Strelinger & Co., Chas. A., Detroit, Mich.
Wiley & Sons, John, New York.

BORING AND TURNING MILLS.
Betts Machine Co., Wilmington, Del.
Bickford Drill & Tool Co., Cincinnati, O.
Bickford, H., Lakeport, N. H.
Bullard Machine Tool Co., Bridgeport, Conn.
Davis & Egan Machine Tool Co., Cincinnati, O.
Niles Tool Works Co., Hamilton, O.
Pond Machine Tool Co., Plainfield, N. J.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., William, Philadelphia, Pa.

BOXES.
Pryibil, P., New York.

BUSHINGS.
New Process Raw Hide Co., Syracuse, N. Y.

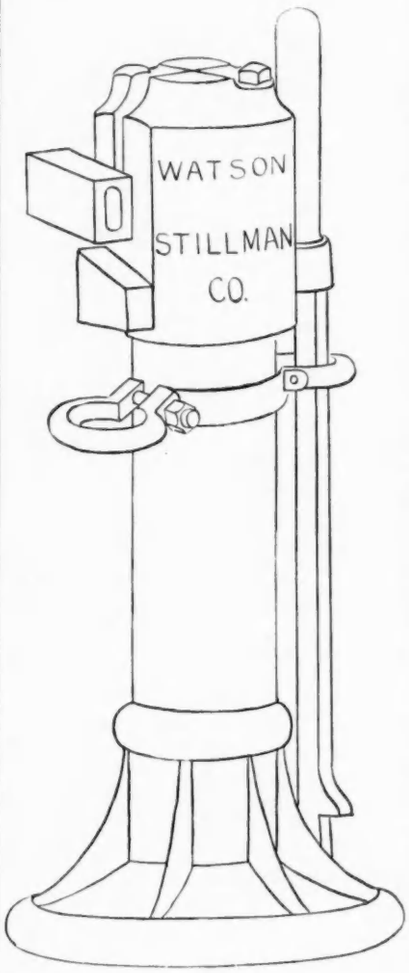
CALIPERS.
Brown & Sharpe Mfg. Co., Providence, R. I.
Smith, E. S., Columbia, Pa.
Standard Tool Co., Athol, Mass.
Strelinger & Co., Chas. A., Detroit, Mich.
Wilkinson & Co., A. J., Boston, Mass.

CAMS.
Newark Machine Tool Co., Newark, N. J.

CASTINGS, IRON.
Builders Iron Foundry, Providence, R. I.
Shriver & Co., T., New York.

CEMENTS, ETC.—FIRE-PROOF.
Johns Mfg. Co., H. W., New York.

THE FACT THAT WE MAKE 277 DISTINCT VARIETIES OF HYDRAULIC JACKS AND HAVE SUPPLIED THOUSANDS FOR ALL KINDS OF PURPOSES, MADE A WELL-KNOWN ENGINEER ONCE SAY THAT WE ARE



"JACK MAKERS TO THE UNIVERSE."

Ask for Cat. D. Address

WATSON-STILLMAN CO.,
202 EAST 43d ST.,
NEW YORK.

Anything in Hydraulics.

CENTERING DRILL.
Slocomb & Co., J. T., Providence, R. I.

CHUCKS, DRILL.
Almond, T. K., Brooklyn, N. Y.
Cushman Chuck Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Oneida Mfg. Chuck Co., Oneida, N. Y.
Pratt Chuck Co., Clayville, N. Y.
Prentiss Tool & Supply Co., New York.
Skinner Chuck Co., New Britain, Conn.
Trump Bros. Machine Co., Wilmington, Del.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Whiton Machine Co., D. E., New London, Conn.

CHUCKS, LATHE.
Cushman Chuck Co., Hartford, Conn.
Hoggson & Pettis Mfg. Co., New Haven, Conn.
Horton & Son Co., E., Windsor Locks, Conn.
National Chuck Co., New York.
Oneida Mfg. Chuck Co., Oneida, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Pratt Chuck Co., Clayville, N. Y.
Prentiss Tool & Supply Co., New York.
Skinner Chuck Co., New Britain, Conn.
Whiton Machine Co., D. E., New London, Conn.

CHUCKS, TAPPING.
National Chuck Co., New York.

CLUTCHES, FRICTION.
Bliss Co., E. W., Brooklyn, N. Y.
Evans Friction Cone Co., Boston, Mass.
New Haven Mfg. Co., New Haven, Conn.

CONDENSERS.
Conover Mfg. Co., New York.
Guild & Garrison, Brooklyn, N. Y.

CORUNDUM WHEELS.
Hampden Corundum Wheel Co., Brightwood, Mass.
Vitrified Wheel Co., Westfield, Mass.

COUPLINGS.
Patterson, Gottfried & Hunter, New York.
Stuart's Foundry and Machine Works, R. J., New Hamburgh, N. Y.

COVERINGS, NON-CONDUCTING PIPE AND BOILER.
Johns Mfg Co., H. W., New York.

CRANES.
Maris Bros., Philadelphia, Pa.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

CUTTING-OFF MACHINES.
Armstrong Mfg. Co., The, Bridgeport, Conn.
Hill, Clarke & Co., Boston, Mass.
Hurlbut-Rogers Mach. Co., So. Sudbury, Mass.

DIES, SCREW CUTTING.
Acme Machinery Co., Cleveland, O.
Besly & Co., Chas. H., Chicago, Ill.
Detrick & Harvey Machine Co., Baltimore, Md.
Jones & Lamson Machine Co., Springfield, Vt.
Montgomery & Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Strelinger & Co., Chas. A., Detroit, Mich.
Wiley & Russell Mfg. Co., Greenfield, Mass.

DRAWING INSTRUMENTS, ETC.
Alteneder & Sons, T., Philadelphia, Pa.
Keuffell & Esser Co., New York.

DRILLING MACHINES.
Adt & Son, John, New Haven, Conn.
Aurora Tool Works, Aurora, Ind.
Barnes Co., W. F. & John, Rockford, Ill.
Betts Machine Co., Wilmington, Del.
Bickford Drill & Tool Co., Cincinnati, O.
Blaisdell & Co., P., Worcester, Mass.
Dallett & Co., Thos. H., Philadelphia, Pa.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Dietz, Schumacher & Boye, Cincinnati, O.
Dwight Slate Machine Co., Hartford, Conn.
Fitchburg Machine Works, Fitchburg, Mass.
Foote, Barker & Co., Cleveland, O.
Fox Machine Co., Grand Rapids, Mich.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Hamilton Machine Tool Co., Hamilton, O.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Mewer Tool Co., Portland, Me.
Montgomery & Co., New York.
Mossberg & Granville Mfg. Co., Attleboro, Mass.
New Haven Mfg. Co., New Haven, Conn
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pond Machine Tool Co., Plainfield, N. J.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Sibley & Ware, South Bend, Ind.
Strelinger & Co., Chas. A., Detroit, Mich.
Timolat, J. G., New York.
Warner & Swasey, Cleveland, O.
Wilkinson & Co., A. J., Boston, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.
Woodward & Rogers, Hartford, Conn.

DRILL GAGE.
Wyke & Co., J., East Boston, Mass.

DRILL RODS.
Abbott, Wheelock & Co., Boston, Mass.
Crescent Steel Co., Pittsburgh, Pa.

DRILLS, TWIST.
Besly & Co., Chas. H., Chicago, Ill.
Cleveland Twist Drill Co., Cleveland, O.
McFadden Co., Philadelphia, Pa.
Montgomery & Co., New York.
Morse Twist Drill & Machine Co., New Bedford, Mass.

DROP FORGINGS.
Wyman & Gordon, Worcester, Mass.

DYNAMOS.
Crocker-Wheeler Electric Co., New York.
General Electric Co., New York.

DYNAMOS, NICKEL-PLATING.
Diamond Machine Co., Providence, R. I.

ELECTRIC MACHINERY.
Crocker-Wheeler Electric Co., New York.
General Electric Co., New York.

ELEVATORS.
Albro-Clem Elevator Co., Philadelphia, Pa.

EMERY WHEELS.
Besly & Co., Chas. H., Chicago, Ill.
Diamond Machine Co., Providence, R. I.
Hampden Corundum Wheel Co., Brightwood, Mass.
Montgomery & Co., New York.
Norton Emery Wheel Co., Worcester, Mass.
Sterling Emery Wheel Co., Tiffin, O.
Strelinger & Co., Chas. A., Detroit, Mich.
Vitrified Wheel Co., Westfield, Mass.

ENGINES, GAS AND GASOLINE.
Otto Gas Engine Works, Philadelphia, Pa.
Pierce Engine Co., Racine, Wis.
Springfield Gas Engine Co., Springfield, O.
Webster Manufacturing Co., Chicago, Ill.

ENGINES, STEAM.
Ames Iron Works, Oswego, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Forbes & Co., W. D., Hoboken, N. J.
Frick Co., The, Waynesboro, Pa.
Greenfield, W. G. & G., East Newark, N. J.
Keystone Engine & Mach. Works, Phila., Pa.
Sturtevant Co., B. F., Boston, Mass.
Weston Engine Co., Painted Post, N. Y.
Wetherill Mach. Co., James P., Chester, Pa.

FEED WATER HEATERS AND PURIFIERS.
Hoppes Mfg. Co., Springfield, O.
National Pipe Bending Co., New Haven, Conn.
Taunton Locomotive Mfg. Co., Taunton, Mass.

FILES.
Arcade File Works, New York.
Besly & Co., Chas. H., Chicago, Ill.
McFadden Co., Philadelphia, Pa.
Montgomery & Co., New York.
Nicholson File Co., Providence, R. I.
Reynolds Bros., Columbus, O.
Strelinger & Co., Chas. A., Detroit, Mich.

FIRE-PROOF CONSTRUCTION MATERIALS.
Johns Mfg. Co., H. W., New York.

FORGES.
American Gas Furnace Co., New York.
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant Co., B. F., Boston, Mass.
Wilkinson Co., The, Chicago, Ill.

FRICTION CONES.
Evans Friction Cone Co., Boston, Mass.

FURNACES.
American Gas Furnace Co., New York.
Brown & Sharpe Mfg. Co., Providence, R. I.

GAGES.
Brown & Sharpe Mfg. Co., Providence, R. I.
Coffin & Leighton, Syracuse, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Wyke & Co., J., East Boston, Mass.

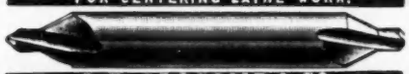
GEAR CUTTERS.
Brainard Milling Machine Co., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Gould & Eberhardt, Newark, N. J.
Grant Gear Works, Boston, Mass.
Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whiton Mach. Co., D. E., New London, Conn.

GEARS.
Bilgram, Hugo, Philadelphia, Pa.
Boston Gear Works, Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Grant Gear Works, Boston, Mass.
New Process Raw Hide Co., Syracuse, N. Y.
Shriver & Co., T., New York.

GRAPHITE.
Dixon Crucible Co., Joseph, Jersey City, N. J.

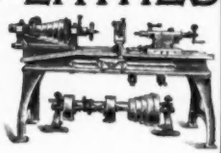
GRINDING AND POLISHING MACHINES.
Besly & Co., Chas. H., Chicago, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Builders Iron Foundry, Providence, R. I.

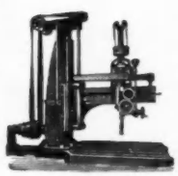
NEW HAVEN MFG. CO.
Manufacturers of
SHAPERS, SLOTTERS, PLANERS, LATHES, DRILLS, etc.
NEW HAVEN, CONN.
Catalogue AC.

COMBINED DRILL AND COUNTERSINK
FOR CENTERING LATHE WORK.

J. T. SLOCOMB & CO., PROVIDENCE, R.I. U.S.A.

Caliper Squares
Any style or Graduation. 5 sizes, Metric and Vernier System.
WARRANTED ACCURATE.
Send for Catalog and Special Prices to
E. G. SMITH, Columbia, Pa.

Gear Cutting Machines,
Milling Machine, and General Line of Machine Shop Tools.
Hill, Clarke & Co.
160 Oliver Street, BOSTON.
16 S. Canal St., Chicago.

BRASS ✲ LATHES
and General Line of Machine Shop Tools.

Hill Clarke & Co.
160 Oliver St., Boston.
16 So. Canal St., Chicago


Radial Drills
and General Line of Machine Shop Tools.
Hill, Clarke & Co.
160 Oliver St., BOSTON.
16 S. Canal St., Chicago.

We manufacture a complete line of : :
DRILLS
for light work, one or more SPINDLES, : hand or automatic feed, of thorough workmanship and strictly up to date. - : :
Prompt delivery on regular styles. :
New Catalogue on application. : :
DWIGHT SLATE MACHINE CO.....
HARTFORD, CONN.

Chas. Churchill & Co., Ltd., London and Birmingham.
Schuchardt & Schutte, Berlin, Germany.

GRINDING AND POLISHING MACHINES—Continued.
Diamond Machine Co., Providence, R. I.
Garvin Machine Co., New York.
Hill, Clarke & Co., Boston, Mass.
Landis Bros., Waynesboro, Pa.
Norton Emery Wheel Co., Worcester, Mass.
Prentiss Tool & Supply Co., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Strelinger & Co., Chas. A., Detroit, Mich.
Wells Bros. & Co., Greenfield, Mass.

GRINDERS, CENTER.
Barker & Co., William, Cincinnati, O.
Diamond Machine Co., Providence, R. I.
Trump Bros. Machine Co., Wilmington, Del.

GRINDING MACHINE, COCK.
Foote, Barker & Co., Cleveland, O.

GRINDING MACHINE, CUTTER.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Diamond Machine Co., Providence, R. I.
Foote, Barker & Co., Cleveland, O.
Garvin Machine Co., New York.
Hill, Clarke & Co., Boston, Mass.
Norton Emery Wheel Co., Worcester, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Woodward & Rogers, Hartford, Conn.

GRINDING MACHINE, SURFACE.
Brown & Sharpe Mfg. Co., Providence, R. I.
Woodward & Rogers, Hartford, Conn.

GRINDING MACHINE, UNIVERSAL.
Brown & Sharpe Mfg. Co., Providence, R. I.
Diamond Machine Co., Providence, R. I.
Landis Bros., Waynesboro, Pa.

HACK SAWS.
Besly & Co., Chas. H., Chicago, Ill.
Montgomery & Co., New York.
Q. & C. Co., Chicago, Ill.
Strelinger & Co., Chas. A., Detroit, Mich.

HAMMERS, DROP.
Bliss Co., E. W., Brooklyn, N. Y.
Long & Allstatter Co., Hamilton, O.
Miner & Peck Mfg. Co., New Haven, Conn.
Mossberg & Granville Mfg. Co., Attleboro, Mass.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Stiles & Fladd Press Co., Watertown, N. Y.
Stiles & Parker Press Co., Brooklyn, N. Y.

HAMMERS, POWER.
Bradley Co., The, Syracuse, N. Y.
Bremer Machine Co., G. J., Kalamazoo, Mich.
Hill, Clarke & Co., Boston, Mass.

HANGERS.
Pryibil, P., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

HOISTS.
Maris Bros., Philadelphia, Pa.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

HYDRAULIC MACHINERY.
The Watson-Stillman Co., New York.

INJECTORS.
Penberthy Injector Co., Detroit, Mich.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

JACKS, LEVELING.
Newark Machine Tool Co., Newark, N. J.

KEYWAY CUTTER.
Baker Bros., Toledo, O.

LATHES (see also Turret Lathes).
Barnes Co., W. F. & John, Rockford, Ill.
Blaisdell & Co., P., Worcester, Mass.
Bradford Mill Co., The, Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Machine Tool Co., Bridgeport, Conn.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Diamond Machine Co., Providence, R. I.
Dietz, Schumacher & Boye, Cincinnati, O.
Fifield Tool Co., Lowell, Mass.
Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Nashua, N. H.
Gould & Eberhardt, Newark, N. J.
Hendey Machine Co., Torrington, Conn.
Hill, Clarke & Co., Boston, Mass.
Le Blond, R. K., Cincinnati, O.
Lodge & Shipley Machine Tool Co., Cincinnati, O.
McCabe, J. J., New York.
McFadden Co., Philadelphia, Pa.
New Doty Mfg. Co., Janesville, Wis.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pond Machine Tool Co., Plainfield, N. J.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Sebastian Lathe Co., Cincinnati, O.
Sebastian-May Co., Sidney, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.
Stark, John, Boston, Mass.
Torrington Mfg. Co., Torrington, Conn.

MACHINISTS' TOOLS AND SUPPLIES.

Montgomery & Co., New York.
Patterson, Gottfried & Hunter, Ltd., New York.
Sawyer Tool Co., Athol, Mass.
Standard Tool Co., Athol, Mass.

MILLING ATTACHMENT.

Adams Co., The, Dubuque, Iowa.

MILLING CUTTERS.

Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Erlandsen, J., New York.
Garvin Machine Co., New York.
Reinecker, J. E., Chemnitz-Gablenz, Germany.

MILLING MACHINES.

Brainard Milling Machine Co., Boston, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Machine Co., Cincinnati, O.
Clough, R. M., New Haven, Conn.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Forbes & Co., W. D., Hoboken, N. J.
Garvin Machine Co., New York.
Hill, Clarke & Co., Boston, Mass.
Kempsmith Machine Tool Co., Milwaukee, Wis.
McCabe, J. J., New York.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Ott, Mergenthaler & Co., Baltimore, Md.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Reed Co., F. E., Worcester, Mass.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MOTORS, ELECTRIC.

Crocker-Wheeler Electric Co., New York.
Dallett & Co., Thos. H. Philadelphia, Pa.
General Electric Co., New York.

NEEDLE WIRE.

Abbott, Wheelock & Co., Boston, Mass.

PACKING.

Central Packing Works, Philadelphia, Pa.
Jenkins Bros., New York
Johns Mfg. Co., H. W., New York.

PAINTS, FIRE-PROOF.

Johns Mfg. Co., H. W., New York.

PATENT ATTORNEYS.

Bates, H. H., Washington, D. C.
Dyer & Driscoll, New York.
Wedderburn & Co., John, Washington, D. C.

PATTERN LETTERS.

Montgomery & Co., New York.
Wells, Heber, New York.

PERFORATED METALS.

Harrington & King Perforating Co., The, Chicago, Ill.

PHOSPHOR BRONZE.

Phosphor Bronze Smelting Co., Ltd., Philadelphia, Pa.

PIPE, BENT.

National Pipe Bending Co., New Haven, Conn.

PIPE CUTTING AND THREADING MACHINES.

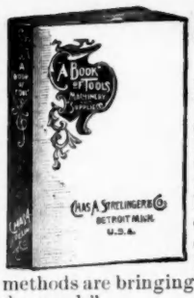
Armstrong Mfg. Co., The, Bridgeport, Conn.
Curtis & Curtis, Bridgeport, Conn.
Detrick & Harvey Machine Co., Baltimore, Md.
Hill, Clarke & Co., Boston, Mass.
National Machinery Co., Tiffin, O.
Saunders' Sons, D., Yonkers, N. Y.
Wells Bros. & Co., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

PLANERS.

Betts Machine Co., Wilmington, Del.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Detrick & Harvey Mach. Co., Baltimore, Md.
Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Nashua, N. H.
Garvin Machine Co., New York.
Gray Co., G. A., Cincinnati, O.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pond Machine Tool Co., Plainfield, N. J.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Whitcomb Mfg. Co., Worcester, Mass.
Wilson, W. A., Rochester, N. Y.

POLISHING WHEELS.

Builders Iron Foundry, Providence, R. I.
Diamond Machine Co., Providence, R. I.



A BOOK OF TOOLS

"Accept my thanks for your 'Book of Tools.' The book itself, and its Prefaces or Introductions, are about the most common-sense things I have seen for a long time. I hope and do not doubt that your enterprise and straightforward 'horse-sensy' methods are bringing you the trade and profit deserved."

ROBERT GRIMSHAW, Engineer, New York.

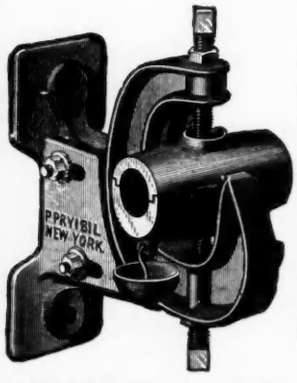
No user or buyer of Tools, Machinery and Supplies can afford to be without this catalogue. It contains 550 pages, over 2 000 illustrations, and is the most comprehensive work of its kind ever issued. Sent post-paid to any address upon receipt of 25 cents in stamps.

CHAS. A. STRELINGER & CO.
DETROIT, MICH.

Smoothbore Hangers.

Our boxes are reamed on a special machine which leaves the bearing exceedingly smooth and very accurate. They hold sufficient oil for three to six months. Durability and good workmanship **guaranteed.**

HANGERS



THIS SLIDING HOOK POST HANGER is adjustable in all directions—in and out, up and down. We have it in assorted sizes of diameter and reach. **Hangers of all styles** a specialty. We carry large stocks for immediate shipment. **Don't make hangers. It doesn't pay.** Get our **booklet** and discount and see for yourself.

NEAT DESIGNS. CORRECT PROPORTIONS. ACCURATE WORKMANSHIP.

P. PRYIBIL, 512 to 524 West 41st Street, NEW YORK.

Telegrams "Pryibil, Newyork." A B C Code used.

MARK YOUR TOOLS WITH A STEEL STAMP

OHIO F. A. SACKMANN. 34 PROSPECT ST. CLEVELAND, OHIO.

SEND FOR PRICE LIST No. 4.

New 20-in. Combination Drill,

A most valuable machine for general use. Ask for Drill Book C.

Sibley & Ware, S. Bend, Ind.

PRESSES, DIES, ETC.

Adt & Son, John, New Haven, Conn.
Bliss Co., E. W., Brooklyn, N. Y.
Bremer Machine Co., G. J., Kalamazoo, Mich.
Ferracute Machine Co., Bridgeton, N. J.
McCabe, J. J., New York.
Mossberg & Granville Mfg. Co., Attleboro, Mass.
New Doty Mfg. Co., Janesville Wis.
Stiles & Fladd Press Co., Watertown, N. Y.
Stiles & Parker Press Co., Brooklyn, N. Y.
Toledo Machine & Tool Co., The, Toledo, O.

PUBLICATIONS.

Compressed Air, New York.
Home Study, Scranton, Pa.

PUMPING MACHINERY.

Deane Steam Pump Co., Holyoke, Mass.
Greenfield, W. G. & G., East Newark, N. J.
Guild & Garrison, Brooklyn, N. Y.
Wetherill Mach. Co., James P., Chester, Pa.

PUNCHES AND SHEARS.

Bliss Co., E. W., Brooklyn, N. Y.
Bremer Machine Co., G. J., Kalamazoo, Mich.
Buffalo Forge Co., Buffalo, N. Y.
Davis & Egan Machine Tool Co., Cincinnati, O.
Long & Allstatter Co., Hamilton, O.
McCabe, J. J., New York.
Mossberg & Granville Mfg. Co., Attleboro, Mass.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Watson-Stillman Co., The, New York.

RAW HIDE.

New Process Raw Hide Co., Syracuse, N. Y.

REAMERS.

Cleveland Twist Drill Co., Cleveland, O.
Morse Twist Drill & Machine Co., New Bedford, Mass.
Ott, Mergenthaler & Co., Baltimore, Md.
Pratt & Whitney Co., Hartford, Conn.
Wiley & Russell Mfg. Co., Greenfield, Mass.

RIVETING MACHINE.

Adt & Son, John, New Haven, Conn.

ROCK DRILLS.

Ingersoll-Sergeant Drill Co., New York.
Rand Drill Co., New York.

ROLLING MILLS.

Mossberg & Granville Mfg. Co., Attleboro, Mass.

ROOFING ASBESTOS.

Johns Mfg. Co., H. W., New York.

RULES, GRADUATED STEEL.

Coffin & Leighton, Syracuse, N. Y.
Darling, Brown & Sharpe, Providence, R. I.
Sawyer Tool Co., Athol, Mass.
Standard Tool Co., Athol, Mass.
Wyke & Co., J., East Boston, Mass.

SAWS.

Q. & C. Co., Chicago, Ill.

SAWING MACHINES, METAL.

Q. & C. Co., Chicago, Ill.

SCHOOLS.

Columbia University, New York.
International Correspondence Schools, Scranton, Pa.

SCREW MACHINES (see Turret Lathes).

SCREWS, MACHINE.

Cleveland Machine Screw Co., Cleveland, O.
Flather & Co., Nashua, N. H.
McFadden Co., Philadelphia, Pa.
Worcester Machine Screw Co., Worcester, Mass.

SCREW PLATES.

Machinists' Supply Co., Chicago, Ill.
Reece, Edw. J., Greenfield, Mass.
Wells Bros., Greenfield, Mass.
Wiley & Russell Mfg. Co., Greenfield, Mass.

SCREWS.

Cleveland Machine Screw Co., Cleveland, O.
Worcester Machine Screw Co., Worcester, Mass.

SEPARATORS, STEAM.

Keystone Engine and Machine Works, Philadelphia, Pa.

SHAFTING, ETC.

Cumberland Iron & Steel Shafting Co., Cumberland, Md.
Pryibil, P., New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

SHAPERS.

Betts Machine Co., Wilmington, Del.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Fitchburg Machine Works, Fitchburg, Mass.
Flather & Co., Nashua, N. H.

SHAPERS.—Continued.

Fox Machine Co., Grand Rapids, Mich.
Garvin Machine Co., New York.
Gould & Eberhardt, Newark, N. J.
Hendey Machine Co., Torrington, Conn.
Hill, Clarke & Co. Boston, Mass.
McCabe, J. J., New York.
New Haven Mfg. Co., New Haven, Conn.
Niles Tool Works Co., Hamilton, O.
Pratt & Whitney Co., Hartford, Conn.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

SHEARS, ROTARY.

Bethlehem Fdy. & Machine Co., South Bethlehem, Pa.

SLOTTERS.

Betts Machine Co., Wilmington, Del.
Niles Tool Works Co., Hamilton, O.
Sellers & Co., Inc., Wm., Philadelphia, Pa.

SOLDERING FLUID.

Elliott Chemical Works, Newton, Mass.

SPECIAL MACHINERY.

Bliss Co., E. W., Brooklyn, N. Y.
Bremer Machine Co., G. J., Kalamazoo, Mich.
Ott Mergenthaler & Co., Baltimore, Md.
Toledo Machine & Tool Co., The, Toledo, O.
Wetherill Machine Co., James P., Chester, Pa.

STEEL STAMPS.

F. A. Sackmann, Cleveland, O.

STEEL.

Abbott, Wheelock & Co., Boston, Mass.
Crescent Steel Co., Pittsburgh, Pa.
Jones & Co., B. M., Boston, Mass.
McFadden Co., Philadelphia, Pa.

TAPPING MACHINES.

Woodward & Rogers, Hartford, Conn.

TAPS AND DIES.

McFadden Co., Philadelphia, Pa.
Wiley & Russell Mfg. Co., Greenfield, Mass.

THREADING MACHINES.

Webster & Perks Machine Tool Co., Springfield, O.

TOOL HOLDERS.

Gould & Eberhardt, Newark, N. J.

TRAMWAYS, OVERHEAD.

Coburn Trolley Track Mfg. Co., Holyoke, Mass.

TUBING, FLEXIBLE.

Almond, T. R., Brooklyn, N. Y.

TURRET LATHES (Screw Machines).

Bradford Mill Co., The, Cincinnati, O.
Brown & Sharpe Mfg. Co., Providence, R. I.
Bullard Machine Tool Co., Bridgeport, Conn.
Cleveland Machine Screw Co., Cleveland, O.
Davis & Egan Machine Tool Co., The, Cincinnati, O.
Garvin Machine Co., New York.
Gisholt Machine Co., Madison, Wis.
Hill, Clarke & Co., Boston, Mass.
Jones & Lamson Machine Co., Springfield, Vt
Lodge & Shipley Machine Tool Co., Cincinnati, O.
McCabe, J. J., New York.
Niles Tool Works Co., Hamilton, O.
Niles Tool Works Co., New York.
Pratt & Whitney Co., Hartford, Conn.
Prentiss Tool & Supply Co., New York.
Warner & Swasey, Cleveland, O.

VALVES.

Jenkins Bros., New York.

VENTILATING FANS.

Backus Water Motor Co., Newark, N. J.
Buffalo Forge Co., Buffalo, N. Y.
Sturtevant & Co., B. F., Boston, Mass.

VENTILATORS.

Pancoast Ventilator Co., Philadelphia, Pa.

VISES.

Hill, Clarke & Co., Boston, Mass.
McCabe, J. J., New York.
McFadden Co., Philadelphia, Pa.
Niles Tool Works Co., New York.
Place Machine Co., George, New York.
Strelinger & Co., Chas. A., Detroit, Mich.
Wyman & Gordon, Worcester, Mass.

WATER MOTORS.

Backus Water Motor Co., Newark, N. J.

WIRE MACHINERY.

Adt & Son, John, New Haven, Conn.
Goodyear, S. W., Waterbury, Conn.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Waterbury Machine Co., Waterbury, Conn.

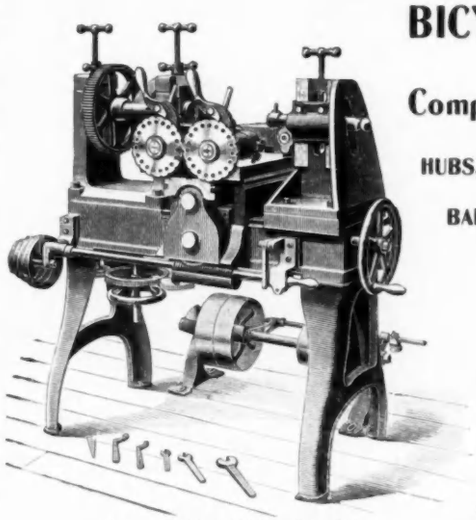
WOODWORKING MACHINERY.

Barnes Co., W. F. & John, Rockford, Ill.
J. A. Fay & Egan Co., Cincinnati, O.
Pryibil, P., New York.
Seneca Falls Mfg. Co., Seneca Falls, N. Y.

TO MAKE BICYCLES

Or Component Parts, at the Lowest Possible Cost, use our

BICYCLE MACHINERY.



Sprocket-Wheel Milling Machine.

WE EQUIP

Complete Up-to-Date Plants

FOR MAKING

HUBS, CONES, SPROCKETS, CHAINS, AXLES, STEPS, BALL CASES, PEDAL SPINDLES, SPOKE NIPPLES, NUTS, SCREWS, ETC.

WE MANUFACTURE

MACHINE TOOLS

And Machinery of all kinds.

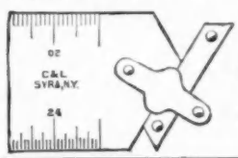
SEND FOR OUR ILLUSTRATED CATALOGUE AND LIST OF NEW AND SECOND-HAND MACHINERY FOR IMMEDIATE DELIVERY.

The Garvin Machine Co.

Spring and Varick Sts., NEW YORK.

Also 51 North 7th Street, PHILADELPHIA.

SOMETHING NEW!



Adjustable Notch Center Gauge.

Price, Post-paid, 50c.

Coffin & Leighton, SYRACUSE, N. Y.

For INVENTORS and PROMOTERS

WANTED: Some easy selling electrical or mechanical specialty, by well equipped Machine Works. Would manufacture under royalty, or buy privilege outright. Address, "SPECIALTY," care AMERICAN MACHINIST.

THE ONLY **"GENUINE"**

Diagonal Piston and Pump Packing.

Samples and Prices on Application.

CENTRAL PACKING WORKS—C. Hartley Miller, 115 N. 6th St., Philadelphia.

Patent Carrying Track

OVERHEAD TRAMWAY

for Mills, Foundries, Machine Shops, or for Merchandise. *Send for Book.*

The Coburn Trolley Track Mfg. Co., ... HOLYOKE, MASS ...

Drill Chucks.

TRUMP BROS. MACHINE CO.

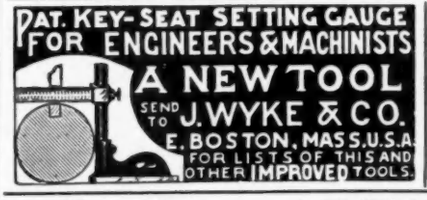
MANUFACTURERS,

WILMINGTON, DEL., U. S. A.

For Sale by CHAS. CHURCHILL & CO., Ltd., LONDON, ENG.

"A Machine Shop with modern equipment, heavy and light machinery, cranes of 20 tons capacity and 10,000 square feet of unoccupied floor space. Would contract to manufacture any kind of machinery."

Address: BOX 62, AMERICAN MACHINIST.


PAT. KEY-SEAT SETTING GAUGE
FOR ENGINEERS & MACHINISTS
A NEW TOOL
SEND TO J. WYKE & CO.
E. BOSTON, MASS. U.S.A.
FOR LISTS OF THIS AND OTHER IMPROVED TOOLS.

KIDD DRILL RODS AND NEEDLE WIRE,

MANUFACTURED BY THE KIDD STEEL WIRE COMPANY, Limited.

All our Rods and Wire made from the finest grade of steel, especially designed for the purpose and drawn very accurate to size. Large stocks in our warehouses.

ABBOTT, WHEELOCK & COMPANY, Agents, NEW YORK, BOSTON AND CHICAGO.

A Time Saver. LEVELING JACKS or Adjustable Blocking.

For the PLANER and GENERAL MACHINE SHOP USE.

With this tool the work can be set rapidly to any degree of refinement, and without danger of springing the casting by strap pressure.

THE NEWARK MACHINE TOOL WORKS, NEWARK, N. J.

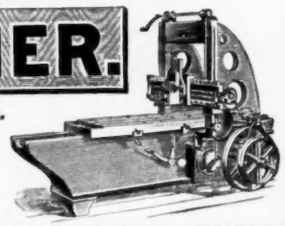
The Niles Tool Works Company, Engineers and Builders.

Machine Tools, All Types and Sizes.

Invite Correspondence. Have Interesting Literature, Photos, Etc., to send.
Main Office and Works: Hamilton, Ohio. Branches: New York, Boston, Philadelphia, Chicago, Pittsburgh.

PLEASE MENTION THIS PAPER WHEN WRITING.

THE GRAY PLANER.



THE G. A. GRAY CO., CINCINNATI, O.

These machines may be seen at following places:
J. A. FAY & EGAN CO., 34 South Canal Street, CHICAGO.
STRONG, CARLISLE & TURNEY CO., 193 Bank Street, CLEVELAND, O.
E. A. KINSEY & CO., 331 West Fourth Street, CINCINNATI, O.
THOS. K. CAREY & BROS. CO., 26 Light Street, BALTIMORE, MD.
J. J. McCABE, 14 Dey Street, NEW YORK CITY.
SCHUCHARDT & SCHUTTE, BERLIN, C., Germany.
CHAS. CHURCHILL & CO., LTD., LONDON and BIRMINGHAM, England.

"Every machine running in your works is a monument to your intelligence or ignorance—a money maker or a money eater.

The Flat Turret Lathe will do nearly all of your lathe work under 2 inches in diameter and less than 24 inches long. It will save $1,000 to $1,500 over lathe work, and $400 to $600 over any other turret machine. Sold on guarantees. Our own representatives will call on request. "Rapid Lathe Work" sent free.

▲ ▲ ▲

IONES & LAMSON MACHINE CO.
Springfield, Vt.

UNIFORMITY
Our reputation for 30 years
ANY MAKER can produce good files OCCASIONALLY

NICHOLSON FILE CO.

PROVIDENCE, R. I., U. S. A.

NICHOLSON files are NOT OCCASIONALLY good; they are ALWAYS good. They are UNIFORM.

Files Best for the Money

Arcade File Works

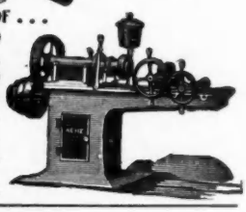
SOLE MAKERS
WEED'S PAT. INCREMENT CUT FILES,
GUARANTEED TO CUT FASTER AND WEAR LONGER.
Anderson, Ind. (Works). CHICAGO, 118 Lake st. NEW YORK, 97 Chambers st.

Write for Useful Souvenir Free to File Users. N. Y. Office.

THE ACME Machinery Co.

CLEVELAND, O.

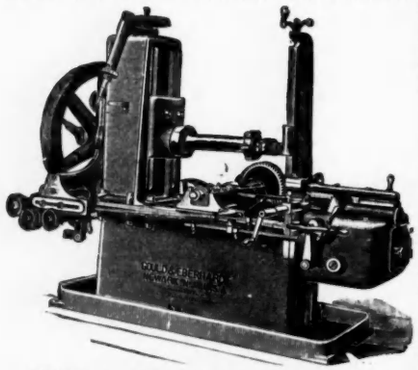
MANUFACTURERS OF . . .
ACME BOLT AND RIVET HEADERS, ACME SINGLE AND DOUBLE AUTOMATIC BOLT CUTTERS, cutting from 1-8 in. to 6 in. diam.
ALSO SEPARATE HEADS AND DIES.



Shaping, Slotting and Shearing Machines.
Emery Hydraulic Testing Machines.
Lathes for Screw Cutting and Turning.
Lathes for Wheel and Axle Turning.
Electric and Power "Jib" and "Traveling" Cranes.
Riveting, Punching and Planing Machines.
Shafting, Pulleys, Couplings, etc., etc.

WILLIAM SELLERS & CO. (Incorporated), PHILADELPHIA, PA.

ENTIRELY AUTOMATIC
GEAR CUTTER
AND PATENT DUPLEX CUTTERS.



GOULD & EBERHARDT, Newark, N. J.

JOHN LANG & SONS, JOHNSTONE, SCOTLAND, Sole Agents on Gear Cutters for Great Britain.
SCHUCHARDT & SCHUTTE, GENERAL AGENTS, Berlin, Germany; 17 Breitegasse, Vienna, Austria.

GREAT INDUCEMENTS

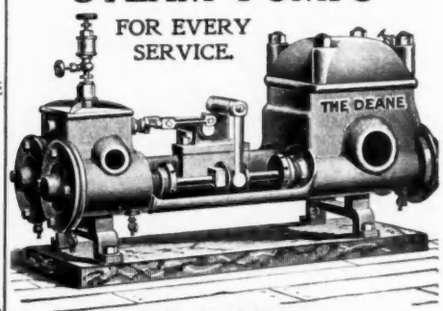
FOR SHOP CLUBS TO THE AMERICAN MACHINIST.

See Page 5.

Start One in Your Shop.

The Deane OF HOLYOKE.

STEAM PUMPS
FOR EVERY SERVICE.



Boiler Feed Pump.
DEANE STEAM PUMP CO.
HOLYOKE, MASS.
New York. Boston. Chicago.

AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

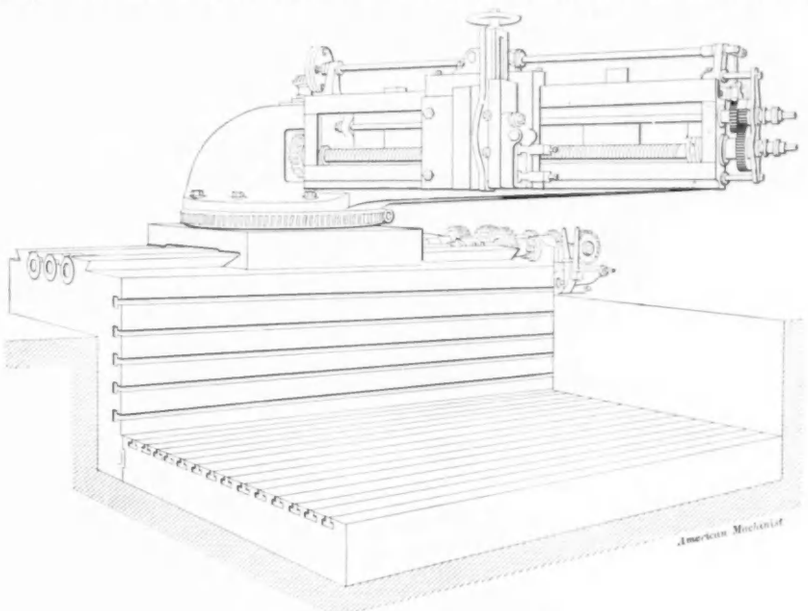
▲ ▲ ▲

VOLUME 19. NEW YORK, THURSDAY, OCTOBER 15, 1896. NUMBER 42.

▲ ▲ ▲

An English Planing Machine.

We find in our English contemporary, "The Engineer" of August 28th, an illustration and description of a novel planing machine, and from our contemporary's engraving have made the accompanying sketch. The machine was built by Hulse & Co., Ordsal Works, Salford, Manchester, England, and is designed to operate on the stern frames of vessels and other large forgings where several surfaces may be required to be planed at various angles. The machine consists essentially of a wide bed plate to which is fitted a saddle which is moved along the bed plate at either a cutting or a feeding rate by twin screws. On this saddle is mounted a radial arm which can be turned in a horizontal plane by a worm wheel and worm. On this arm, which extends about 7 feet beyond the bed plate, is fitted a tool-carrying saddle—this saddle being also capable of two motions, one for feeding and the other for cutting, as may be required.



AN ENGLISH PLANING MACHINE.

The work to be operated upon is fastened to the bed plate, which is supplied with T-slots, as shown, and remains stationary. The work can then, of course, be planed either by the traverse motion of saddle and arm upon the bed plate or by the traverse motion of saddle upon the arm, the bed-plate saddle being in that case given feeding motion. The motion of saddle upon arm may be at any desired angle in a horizontal plane, and in setting work, or when desirable for any other reason, the arm can be swung around parallel with the bed plate. The saddle has a movement of 6 feet upon the bed plate, and the saddle of the radial arm a traverse of 7 feet, both cutting motions having a quick return motion of 2 to 1.

The machine seems to be an elaboration of the Richards side planer idea, and ought to be equally efficient, with some added advantages, especially for heavy and intricate work.

▲ ▲ ▲

In the window of a store on Warren street, this city, a new tire for bicycles is exhibited, having a protecting armor of overlapping steel plates, made of clock-spring material and arranged something like the scales on a snake's belly. The following notice is posted in the window: "To the Amateur Lecturer—Don't try to explain this tire to the public, as you probably don't know what you are talking about; and as we pay a man to do this work, and hate to have him idle, please step inside and get the facts."

Blacksmithing Operations.

Working Cold Metal—Drop Forging—Undercut Dies—A Mortised Die—Fatigue of Metals—Rate of Stress and of Recovery—Proper Heats—Heavy Drops.

BY B. F. SPALDING.

Blacksmithing operations may be defined as those which depend for their effect either upon (*a*) the liquefaction of the surface of the metal, (*b*) the power of forcing the metal to flow when it is not liquified, (*c*) the softening of the metal produced by heat, and also as those (*d*) which aim to produce a desired effect upon iron or steel by changes in temperature, and by the manner and rate of the production of these changes. (*a*) includes welding; (*b*) the operations of drifting, rolling, swaging, wire-drawing and every other thing that requires the displacement of some particles of the metal without separation from the mass; (*c*) cutting, with chisels and saws, into iron and steel, while it is red hot; (*d*) the operations of annealing, hardening, tempering and case-hardening.

Exception might be taken to cold rolling, or cold swaging, or cold drifting, that they are not done by the aid of heat, are not performed by the blacksmith on hot metal, and for these reasons are not blacksmithing operations. But they practically depend upon the flow of the metal, and this again depends upon the condition into which the metal has been brought by heat. For this the blacksmith is responsible; not, perhaps, the recognized blacksmith in the shop, but someone who exercises the functions of the blacksmith. The blacksmith is responsible for the quality of material in the forgings which come from any establishment. The blacksmith I allude to is the person who exercises the functions of the blacksmith; decides what material to use, and how to use it. The man who handles it is no more responsible for its condition, if he handles it as he is bidden, than the machine is, in which it is worked. To be responsible, he must have the kind of stock he wants, and the liberty to work it in the manner which his judgment approves.

The practice of forcing steel and iron into close dies with the drop hammer evidently tends to their consolidation. It

is one of the operations which depend upon the flow of the unliquified metal. The use of the drop is sometimes made at a disadvantage, because the shape of the forging is such that, in order to drop it in the desired position, the dies must be under-cut, and this appears objectionable; but this appearance may prove to be deceitful upon closer examination.

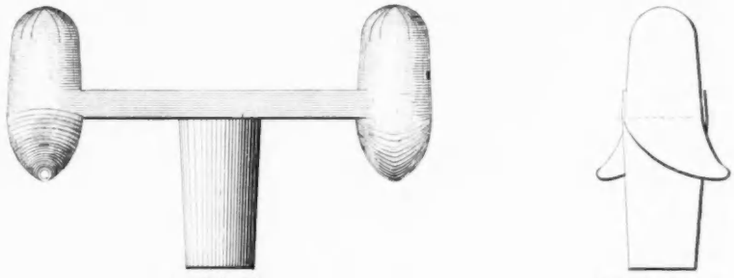
The clearance, or draught, of the upper die of a pair of drop dies must be made so that the die can be lifted freely from the piece which is struck up in it, in a line perpendicular to the drop bed, for that is the line in which it is forced to move after the blow has been struck. But although the forged piece must allow the top die to go up straight, it does not follow that it must be taken out of the lower die in the same direction. It may be lifted out of the lower die in a line inclined to the bed in any direction, for it is in the flexible hands of the operator, who can move it to the right, or left, obliquely, as well as directly upward. This facility permits the lower die to be under-cut in any way, subject to the provision that it has draught in accordance. When dies are made in the manner indicated, they will not without disadvantage interchange places, for although the top die will lift perpendicularly without taking the forging up with it, when the dies are set as designed, if they are reversed, and the lower die used for the upper, it will take the piece up with it unless the operator is dexterous enough to release it as soon as it clears the open cut die.

The under-cut die may be under-cut in more than one place, but generally not in more than one direction. In exceptional cases, however, it may be cut under in opposite directions, at the opposite ends, and the piece lifted out by giving it the swing necessary to disengage it. Something of this kind may be seen illustrated in Fig. 1, where *B* is intended to represent an outline of the end view. The parting of the dies is on the dotted line. Swinging the piece around, after the upper die lifts off, will release it from the under-cutting at both ends.

As it is less trouble and expense to make the surfaces of the dies flat than in any other shape, it is customary to make them so when there is any way to set the pieces in such dies in a position that will permit a good parting of the dies with reference to the clearance of the pieces. But pieces are frequently of a shape that cannot be set thus, and the faces of the dies must be shaped to correspond with the parting. It is sometimes necessary to make the surfaces in a shape which cannot be planed. Gun-tumbler dies have been made which were turned in the lathe "cupping," one fitting into the other. This, however, was to insure coincidence. There was nothing in the shape of the dies shown in Fig. 2 but what could be surfaced on the planer, although it was thought advisable to make the parting of the dies somewhat in conformity with the form of the piece. The surface was as indicated by the dotted lines in Fig. 2.

It will be observed that in this instance of under-cutting, as shown at the catch *A*, the lifting of the piece by the curved end will release it from the under-cutting. The extra piece shown in the drawing is not expressly to exhibit the piece as it would appear when lifted to take out, for it would not look that way. The curved dotted line, whose center is at the center of the boss, shows that the boss would have to be drawn out from its impression, on account of the catch *A*, before the back end of the piece got as high as the position shown. The piece is thus drawn to show the position in which it would have to be set in the die if the back side of the catch offset corresponded with the front side. This would make such shaped surface of the dies that when they struck, the blow would give a lively tendency to force them out of line with each other, which is a thing especially to be avoided. It will be seen by the piece shown in the die, that by modifying the shape of the back side of the catch offset, the piece was made so that the top die could lift off, as it lies nearly in a horizontal position, and the dies have no great tendency to move endwise—they nearly balance.

Fig. 3 represents a piece as it lies in a breaking-down die. It was blocked out with the trip hammer, and the blow it received edgewise in these dies was to shape it to enter the flat finish drop dies. They performed this operation on every part except the tang, which was bent over a former, with a blow from a hand hammer, after coming out of the dies, which did not strike that portion. The lower die was mortised through, to admit the tang freely, and the material above the mortise formed a bridge which resisted the blow at *C*, and gave that part of the piece its proper



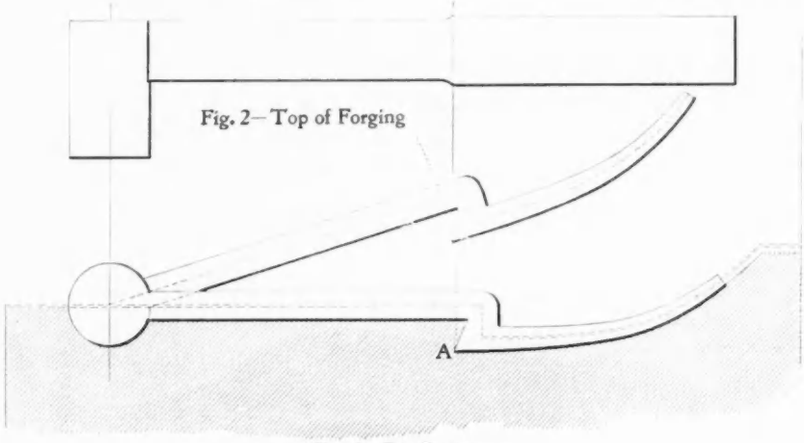


Fig. 2—Die Section

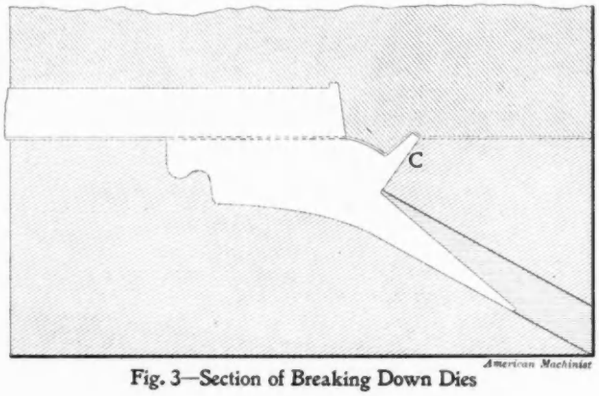


Fig. 3—Section of Breaking Down Dies

shape. The mortise, or channel, was 1⅛ inches wide, which left the bridge short, and with ample abutments to support the blows of a 300-pound drop hammer. The leeway in the channel permitted the piece to be raised at the other end and drawn out toward the operator.

The endurance of the bridge shown in Fig. 3 may serve to illustrate another principle, which might perhaps with propriety be termed "fatigue." In this instance it is illustrated by what it does not do. Fatigue of metals is understood to be a gradual deterioration, or weakening, from the effect of continuous or successive shocks. It is quite probable that blows from a heavier drop would have strained the bridge over the channel beyond its elastic limit; and no matter how little this happened at each blow, yet if it happened in the slightest degree, the inevitable consequence would have been a gradual sagging. If the bridge was never stressed beyond its power of recovery, it would never sag. With regard to the power of recovery, it may be said that as no force can act upon any mass instantaneously, but must have a point of time at which it commences and from which it continues to act until it ceases, so the power of recovery cannot be fully exercised at once, but must have duration of time for progressive action. The nature of all material is such that the action of all force—except the force of gravity inherent to matter, which alone acts instantaneously—must be communicated from particle to particle, and as this requires progression in space, it must also require progression in time.

Recovery may be sudden, or it may be extended over an appreciable period of time. The blow of the drop hammer upon the bridge might have given it a strain from which it had power to recover in a second, in a minute, in five minutes, or perhaps in five years. The rate of recovery, like the return movement of the balance wheel of a watch, has some relation to the impulse, as action and reaction agree, not alone in one, but in several particulars. The duration of the strain is affected by the rate of the stress. Whatever the duration of the strain upon the bridge may have been, if it received the stress of another blow upon it before it recovered from the strain of the first, there would have been an accession to the strain, and if still another blow was struck before recovery, the strain would again be augmented. The effect of accumulation would be obtained. However rapid the repetition of the stress might be, the effect of accumulation would not be obtained if perfect recovery followed each impulse.

A certain number of blows, if struck in rapid succession, will produce an effect different from that which would be produced if a longer time was allowed to intervene between the blows; because, in one case, the effect of each blow is reinforced by the residual effect of the preceding blow, and the total is the result of accumulation; while in the other case, there is nothing to be added, and the total effect of all the blows is only the amount due to one. These broad general principles, narrowed in this application to the die, have a great deal to do with blacksmithing operations, and in this case the action of successive blows which do not permanently affect the dies has a far greater effect upon the stock which is worked in them.

The idea may be conceived of a perfectly elastic substance, that it would be one that would be so absolutely hard, so absolutely rigid, that it would receive, return and even transmit motion as a whole, while none of its particles affected others, and no internal motion was induced; but, practically, recovery from forced impressions determines the elasticity of different substances. Their difference in elasticity does not depend upon their relative hardness, for a brick is not as elastic as a baseball. The elasticity of each substance may depend upon its condition of softness, as a brick is more elastic than clay. So iron and steel lose their elasticity with their hardness when they are softened by heat; and the hot iron or steel, dropped in dies, has little of the power of recovery which the dies have. But however soft they may become, they do not lose all of their elasticity at any heat at which they are worked by the blacksmith.

If a rifle ball is fired out upon the water, it goes skittering along in a manner that seems to show that although water is an incompressible substance it is capable of reaction. Iron which is struck in the dies when it is so nearly a liquid that it requires adroit handling to get it onto them from the fire, flows readily into all parts of the die when it gets the forced pressure of the blow, and the drop staggers about; starting upward, it misses the rebound it gets when the iron is colder—but this is because, according to one law of fluids, the pressure is equalized in all directions, and the force is therefore spent in driving the stock about laterally against the sides and ends. If there is any excess of stock the dies do not come together. It is probable, indeed, that iron in a liquid state is not as compressible as it is when it is not near hot enough to reduce it to that condition. But however soft iron or steel may be, they will exhibit elasticity when they are struck in close dies, for at the moment of impact their bulk is less than it is an instant later, when they swell to recover from the stroke. There is a temperature at which they will best retain the effect of the blow; and this is not, as might be supposed, when the hammer rebounds the least, when the force is spent sidewise, but it is when the stock has firmness enough to hold what it gets, and the pressure is confined principally in the direction of the force.

If the piece which has just been struck in nearly a liquid state is removed from the die and cooled off in the water and broken, it will be found to be of a honeycomb formation, with larger or smaller air cells, and irregular partitions of greater or less thickness. What is the cause? Why should not the stock be compressed? Simply because the blacksmith has been shaping heat instead of metal. The heat filled part of the die; the metal was not struck at that particular heat at which, from the nature of the material, the greatest condensation results from compression. For this reason two light blows upon stock may put it into better condition than one which is twice as hard, or, with the proper heat, this procedure might with advantage be reversed. So much depends upon the various circumstances of size and material, that the best results can only be obtained by trial and inspection.

Drop forging is often attempted at a very great disadvantage, because the hammers are not heavy enough to do the work on the forgings at the proper heat. The operator is forced to burn his stock to make it soft enough for the force at his disposal. Then it is fortunate if he works it enough to restore it to its first condition. The bar of metal is now the blacksmith's raw material. It was formerly his duty to improve his material by the work he put upon it, but the present economy of manufacture demands that it shall be furnished to him of such good quality that the manner in which he can work it with the greater expedition will not make it too poor for the purpose designed. No fault can be found with this arrangement. Who would say that any material which is good enough should not be used, or that the cheapest way to work it is not the best? "A silk purse cannot be made out of a sow's ear;" but a pigskin purse will answer the purpose of a person, who has much use for it, better than a silk one. So of any material—what may not answer for one purpose will be right for another; and in most instances, working stock under a drop of the right proportions will better its quality.

If the material, after it is worked with a heavy drop, is better than when worked with a lighter one, that is a powerful argument in its favor. Whether it is, or is not, is not to be determined by theory. Close examination will show in some cases that there is a great inequality in the material in the larger and smaller parts of a forging which has been struck up at one blow with a heavy drop. The flowed stock, that which has been driven on a run from the body of the stock into some recess in the die, has not received the same treatment that the stock has which remains in its original position, and is different in its internal structure. The practice of trimming off the fin while yet hot, and striking it a blow in finishing dies at the same heat, when it can be done, brings the stock throughout the piece into a uniformly good condition, as in this operation it is subjected to nearly uniform com-

pression at a temperature which adapts it to receive the greatest benefit from the blow.

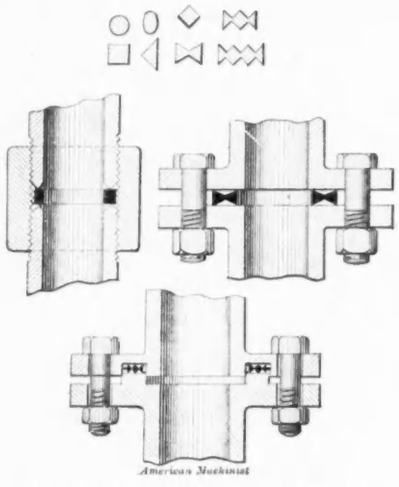
▲ ▲ ▲

Copper Gaskets.

We illustrate herewith several forms of copper gasket which are now made in Germany as a regular article of manufacture. The use of such gaskets is not, of course, new; but when home-made they have, of necessity, had a soldered joint, which not only leaves a point of uncertain strength against high pressures, but also provides a point where the ring is harder than elsewhere, which is obviously undesirable. These gaskets are made seamless, and are hence of uniform strength and softness. They are made of various sections, some of which are shown in the smaller sectional cuts, though the reason for some of them is not quite clear to us. The number of ridges is, however, made to correspond with the pressures employed. Thus, the third section in the bottom row is stated to be suitable for pressures up to twelve atmospheres, while the fourth section of the same row is said to be equal to retaining a pressure of 300 atmospheres.

The engravings of the pipe joints illustrate the method of use.

The gaskets are being imported by J. H. Lau & Co., of 75 Chambers street, New York.

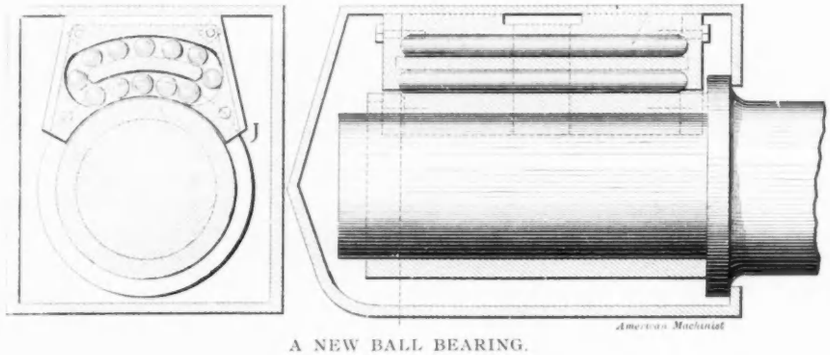


GERMAN MADE COPPER GASKETS.

▲ ▲ ▲

A New Ball Bearing.

Frank McGloin, of New Orleans, La., has patented a ball bearing like that shown in the cross-section, the idea being that balls are placed at the only point where they do any good in service, and the device can be applied to machinery already constructed by simply making a new cap.



A NEW BALL BEARING.

▲ ▲ ▲

The Advantage of the Pneumatic Tire.

An experiment was recently conducted in France to ascertain the practical efficiency of the pneumatic tire in promoting ease of riding and of traction. The results given seem to refer only to the draft. Plain iron wheels were tried under conditions as nearly as possible identical with those under which the pneumatic tires were tried. With 2 inches of melting snow on muddy ground, and moving at a walk, the iron tires required a pull of 35.9 pounds, while the pneumatic tires took only 25.2 pounds. At a trot, and with a load of 660 pounds, the pull was 68.6 and 39.5, respectively. Tests were made at various speeds over macadam, paved and ordinary roads, and in every case the pneumatic tire showed a saving in pulling power of from 30 to 50 per cent., which is a great gain at a comparatively slight cost.

The Libel on the Crank.

Why do not mechanics get up and protest, as they should, against the misuse of the word "crank," as applied to various nondescript, erratic and more or less objectionable individuals? Instead of doing so, we are most of us helping to foster and extend the abuse. The term "eccentric" used to be applied to men whose mental action differed, and often only slightly differed, from the average running of the human mind. Nowadays, if a man develops a compound eccentricity, or becomes, as we might say, eccentrically eccentric, we simply call him a "crank." Mechanically, this is all wrong. The term expresses the antipode of what we mean. The crank travels in an absolutely circumscribed path, and is always associated with rectilinear precision of movement. The fellow that we now left-handedly libel as a "crank" might better be called a "cam."

▲ ▲ ▲

Surgery by Steam Power.

"Probably as queer a piece of backwoods surgery as has been described," says a frequenter of the region, "was that performed by a Moosehead Lake guide known as 'Old Sabattus,' twenty years ago. The man was not an Indian, as the nickname implies, but a Yankee, one of those rough fellows formerly characteristic of that locality. This guide was left on a lake steamboat at one of the far-up landings while the engineer went ashore with the company. A man named Meservey came aboard, and in fooling around the boat, managed to tumble down into the fire pit and put his shoulder out of joint.

"Here was a dilemma. The other members of the party would not be back for half an hour, and the injured man was in great pain. The guide was a man of expedients. He got a rope and tied his patient securely to a post. Then he tied another rope around the man's waist and hitched the loose end of it to a pulley of the engine. He managed somehow to turn on steam and the pulley began to wind up the rope. It drew the arm out tight in beautiful shape and presently the joint snapped back into its socket. Then 'Sabattus' jumped around to shut off steam while the pulley kept on winding. 'Holy Moses,' gasped the guide excitedly, 'how does it go? I don't know where 'tis. I can't stop the blanked thing,' and the pulley meanwhile was slowly but surely pulling Meservey to pieces. His eyes were sticking out of their sockets and he screamed and gasped for breath.

"Sabattus danced around like a wild man, not knowing what to do, when he happened to spy a hatchet lying near, and jumping for that, he cut the rope and saved a dreadful catastrophe."—"Lewiston (Me.) Journal."

▲ ▲ ▲

We are indebted to the author for a copy of a pamphlet reprinted from the "Journal of the United States Artillery," which pamphlet contains a very interesting paper on "Experimental Determination of the Motion of Projectiles Inside the Bore of a Gun." The experiments described were made with the "polarizing photo-chronograph," and were conducted by Dr. Albert C. Crehore, of Dartmouth College, and Dr. Geo. O. Squier, U. S. A. The results as described and illustrated are very interesting, not merely as to their results, but also for the method itself, which gives a new means of measuring very short intervals of time.

De LaVergne Big Boring Mill.

[CONCLUDED.]

The principal problems of large boring-mill design, after the shop-corner location and the use of shop walls to support the crosshead have been adopted, are those relating to the boring bar, the traveling boring-head, the feed, the boring-bar step or bottom support, and the drive. It is also important that both the top and bottom supports of the work in the mill should not prevent making facing cuts. On the top-end of the work the facing cut can cover the whole surface; part of the bottom-end surface must, however, in many cases be used as a support for the work.

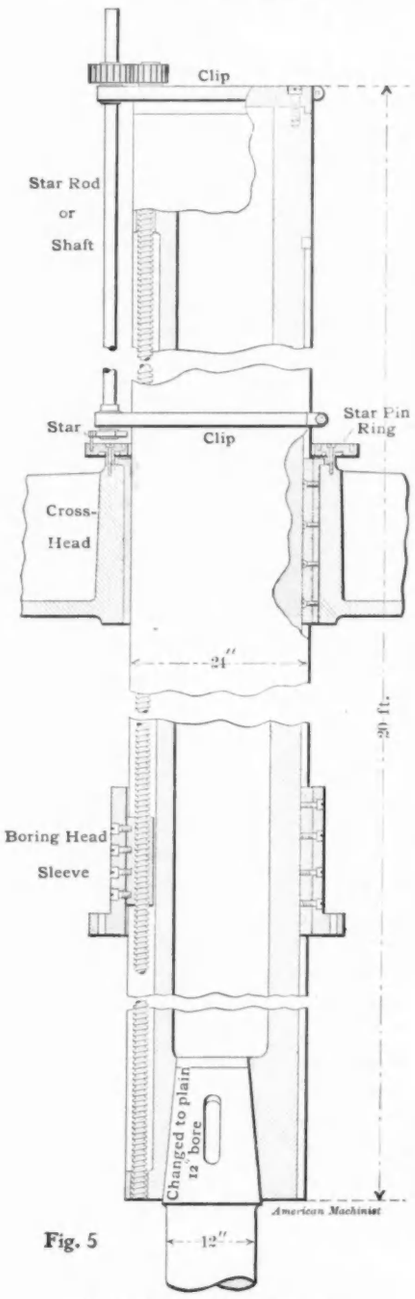


Fig. 5

SECTION OF BORING BAR.

Large boring mills are often equipped with only a single boring bar; the single boring bar must be as large as possible to give stiffness and a steady cut; at the same time it must be as small as may be, in order to carry boring heads capable of boring small diameter work, and the designer at once finds it difficult to fix the most suitable compromise. The De La Vergne designers meet the conditions with two boring bars, one 12 inches and one 24 inches diameter. These call for a bushing in the crosshead bearing, and some sort of easily disengaged driving connection between the driving member and the bars. To make this driving connection, a plain socket 12 inches internal diameter, in the top end of the driving spindle, was at first fixed upon, and the 24-inch bar was drawn as shown in Fig. 5, with a 12-inch taper-shank stem keyed in its lower end to go into this driving-spindle socket. This idea was abandoned, and the nose of the vertical driving spindle was finally brought up through the floor in the form of a plain cylinder, 12 inches diameter, as shown at *S*, Fig. 11. This upright spindle end is bored with a plain straight socket, about 7 inches diameter, I think; to this spindle-end the small bar is fitted by turning the bar-end down to slide into the cylindrical socket, where it is held by keying, and driven by rabbeting across the end, all as shown in Fig. 11, in which *S* is the top end of the driving spindle, and *B* is the bottom end of the small boring bar. The large boring bar is bored out at the lower end to 12 inches diameter to slip over the outside of *S*, and is not fitted internally to fill the rabbet in the top end of *S*, but is driven wholly by a large key which fills the keyway in *S*, and goes through the 24-inch bar from side to side.

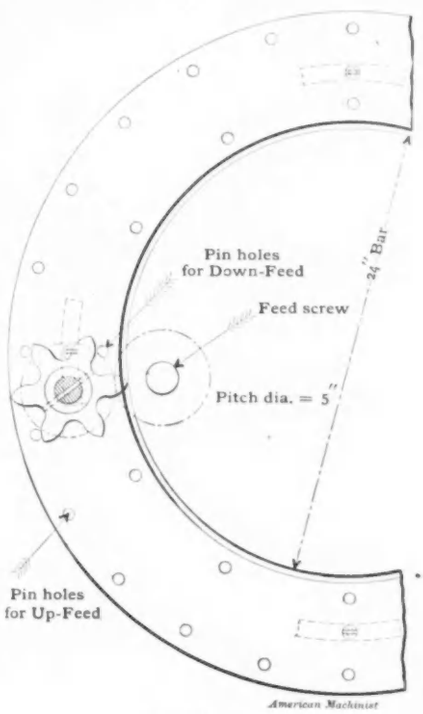


Fig. 6

FEED ARRANGEMENT.

The boring heads must, of course, be of different diameters, to give tool support as near the cutting point as may be, and the tools should be so secured as to avoid dovetailing, or keying, or securing the cutting tools in the head in such a way as to make each cutter a specially fitted piece. Boring heads are often elaborate structures, quite commonly fitted with cutters having the cutting part at right angles to the body, dovetailed in the edge of the boring head disk, secured with carefully fitted keys, and frequently having in addition to these expensive features a setting-out device to regulate the diameter of the cut. It has been also common to make each tool of a 3, 4 or 5 tool boring head with different forms of cutting edge, and to set these different cutters in different advance positions, with the idea of having the leading tool make a roughing cut, and the following tools finishing cuts, although it was always the practice to take a solely finishing cut, most often with a single cutting tool, through a cylinder before it was regarded as a perfect job.

There is a real gain in many cases in variously advancing the tools in a multi-cutter boring head, and also in setting the tools to cut different diameters in the same passage through the work. If the utmost production is sought, it is essential that not less than three cutters should be used, and that the cutter making the smallest bore diameter should be in advance, and the cutter making the largest bore diameter should be behind the other two. In finishing hydraulic-lift cylinders where costly special tools were designed and built in the expectation of obtaining a 1-inch per minute feed rate of boring head, it was found that cutters disposed

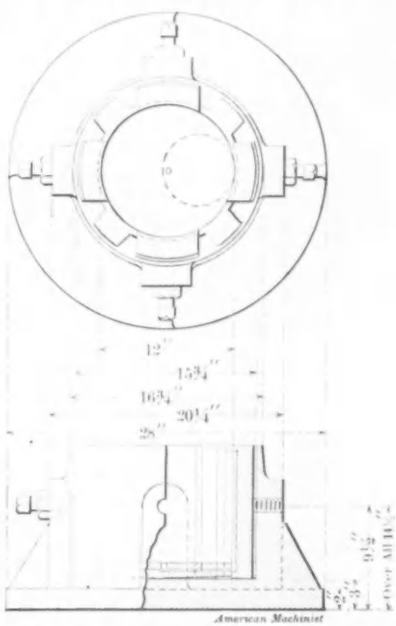


Fig. 7. STEP BEARING FOR BAR.

as specified gave the greatest extent of finished surface, but it was not found possible to reach the desired 1 inch per minute feed. The lift cylinders mentioned were part of a manufacturing job, to be duplicated day in and out, the year round, which made any expense in the way of special tools and elaborate design appropriate and economical.

The boring mill under consideration works under the opposite conditions of very seldom having two similar jobs follow each other. Even if there are large cylinders to duplicate, it is a long time after one comes out of the foundry before another reaches the machine shop, and, as a usual thing, no two identical jobs immediately succeed each other. Under this condition of endless variety of work, the principal requirement of the boring heads of this mill is that they shall be easily and quickly changed on the boring bar, and that the cutting tools shall be cheap and readily set for work. With a weak boring bar, a balanced cut is always desirable, and often indispensable. Where the machine offers a choice between a 12-inch and a 24-inch boring bar, and where this boring bar can have its supports as close together as the length of the work will permit, as in the present case, the boring head cutters are well supported, and it is not absolutely needful that more than one cutter should be used, though it is always desirable in all tool cuts to gain effects as nearly balanced as possible, no matter how stiff the machine may be.

Referring to Fig. 5, the boring head sleeve is flanged at the lower end, and fitted internally with a nut on one side and a feather on the other; the sides of the nut are fitted to the sides of the screw channel, so that there is a balanced two-side drive of the sleeve, which has bolt holes running through its lower flange to take the studs of the different diameter boring heads, one of which, for a 100-inch cylinder, is shown in Fig. 12. This boring head has two T-groove rings, one near the hub and one near the circumference; these grooves take the heads of clamping bolts by which the tools are secured in any desired number or position. One tool stock only is shown clamped to the top flat surface of the boring head in Fig. 12, but a number can be used. The tool stocks are simple slabs of grey iron, fitted at the out end with a heavy strap and two tool-holding studs, planer tool-post fashion, so as to readily take a short-bodied tool exactly the same as an ordinary lathe or planer tool, and having no special fitting about it. The details of the boring-head-sleeve and boring head and its cutter stocks are clearly enough shown by the engravings, and do not need minute description.

To turn the feed screw, a spline shaft carrying a star wheel at its lower end is mounted in removable ring clips which can be secured at any point on the boring bar, as shown in Fig. 5, the spline shaft driving the boring-head feed screw through a pair of 5-inch p. d. spur pinions at the top end of the bar. This spline shaft, carried around by the boring bar, is turned faster or slower by putting more or less pins in the holes in the pin ring, Figs. 5 and 6, and in one direction or the other, accordingly as the star pins are put in the inner or outer circle of holes. This pin ring is secured to the top of the crosshead which carries the top boring-bar support, and the whole feed details are very simple, complete and convenient.

As the weight of the large bar and the boring head may be as much, perhaps, as nine or ten tons, and to this weight may be added the pressure due to the cut, as well as the weight of the largest driving gear and the driving spindle, possibly 25 or 30 tons total, and the step which supports the vertical driving shaft has this load to support, the step-construction shown in Fig. 7 was adopted.

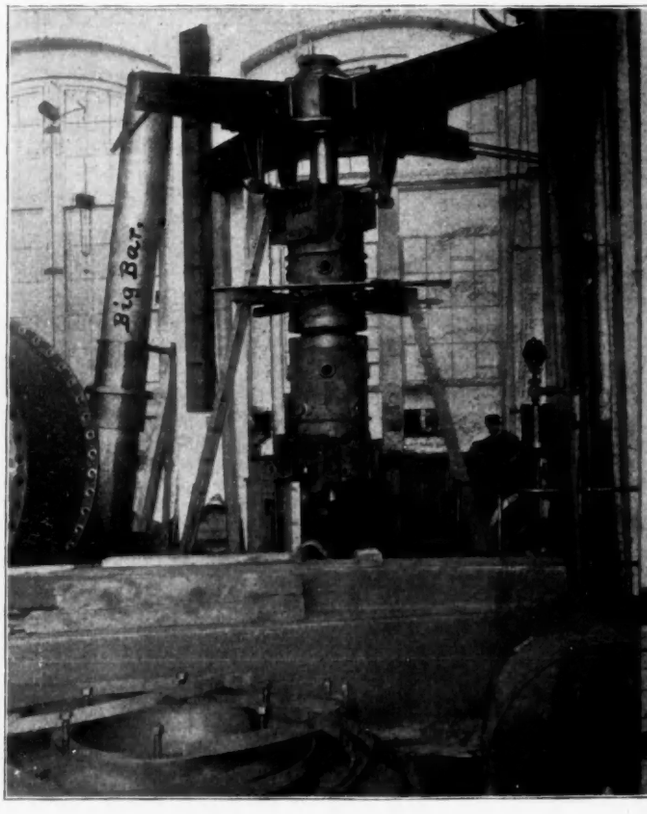


Fig. 8. BORING SMALL CYLINDER.

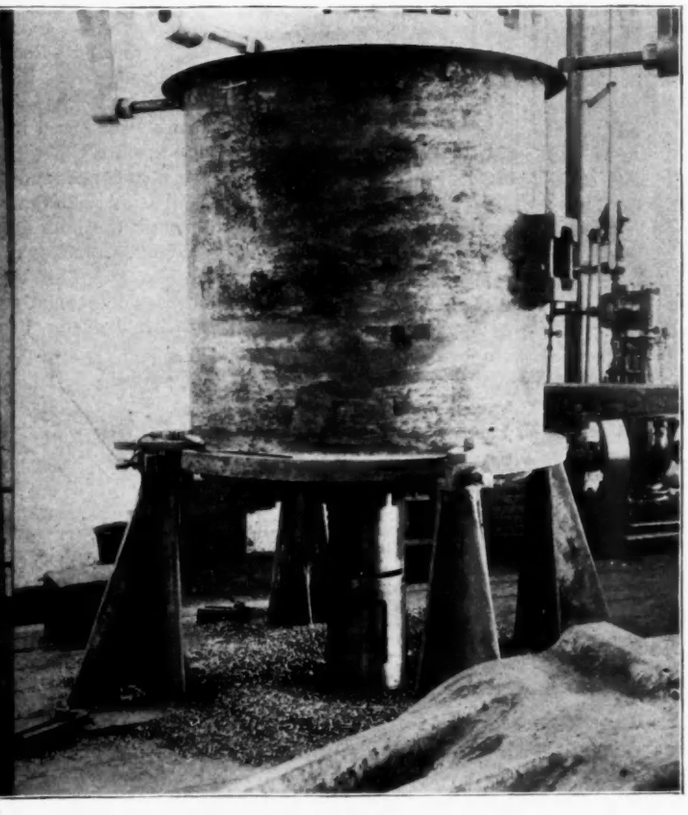


Fig. 10. METHOD OF SUPPORTING A LARGE CYLINDER.

The body of the step is a cylindrical shell with a circular flange base 28 inches diameter, resting on the concrete foundation previously described. The vertical part of the shell is cast with interior ribs which retain four quarter boxes of cast iron faced with babbitt, and held up by a set screw and check nut for each, all as shown in Fig. 7. These quarter boxes can be readily adjusted to the lower end of the upright spindle, which is 12 inches diameter at the bottom. Taking the maximum load at 30 tons gives $\frac{60{,}000}{103}$ pounds $= 582$ pounds per square inch on the bottom of the shaft. To support this is a steel disk,

crowned on the bottom, and recessed as shown on top, with a circular depression ⅛ inch deep and 6 3-16 inches diameter, tangent to the disk circumference; this recess has an area of about 30 square inches. Above this recessed steel disk is laid a disk of vulcanized fiber ½ inch thick by 12 inches diameter, which has a ⅜-inch hole in the middle communicating with the oil recess in the steel supporting disk. The shell of the step is oil-tight, and is kept full of lard oil nearly up to the quarter-box screws, and the theory is that the revolution of the spindle constantly draws oil up through the ⅜-inch hole in the middle of the vulcanized fiber disk and discharges it at the outer circumference, thus perfectly lubricating the end of the shaft, loaded about 822 pounds per square inch after deducting the area of the 6-inch diameter oil recess. This is a step construction which I have not met previously; the load per square inch cannot be called heavy, the oiling seems good, and the step gives no trouble and requires no attention.

It is a very great convenience to have free access to both ends of a large piece in process of boring, and access to the bottom of work in this mill is gained by supporting the piece to be bored on four flanged stands. having planed feet readily clamped in any desired position on the T-grooved top plate of the mill, level with the floor, and provided with finished lugs on which the work sits, adjusting screws and holding-down straps, all shown in Fig. 10. Shorter supports must, of course, be used where a very large and long piece like the cotton press cylinder, Fig. 2 (shown last week), 100 inches diameter by 154 inches long, is to be bored. I did not examine the bottom support of this piece, but think it was bolted on top of pedestals about 30 inches high. In Fig. 8 a much smaller cylinder is being bored with the 12-inch bar, while the big bar stands on end at the left, leaning against the wall; near the top its lifting bail is seen hanging down.

Fig. 14 shows the outer crosshead arm removed, the steadiment box open, and the 12-inch bar pulled out of the same cylinder shown in Figs. 10 and 11. The big bar stands, as in Fig. 8, leaning against the wall. In making changes and setting work, all of the handling of heavy pieces is, of course, done by the overhead traveling crane, 15 tons capacity, which is not nearly powerful enough for the class of work now in progress at the De La

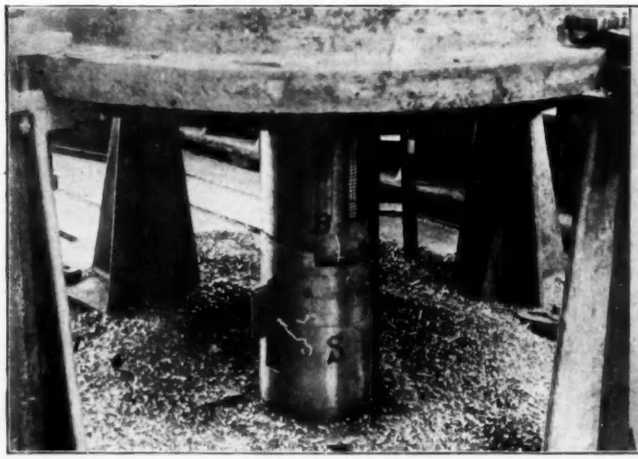


Fig. 11. BORING BAR DRIVER.

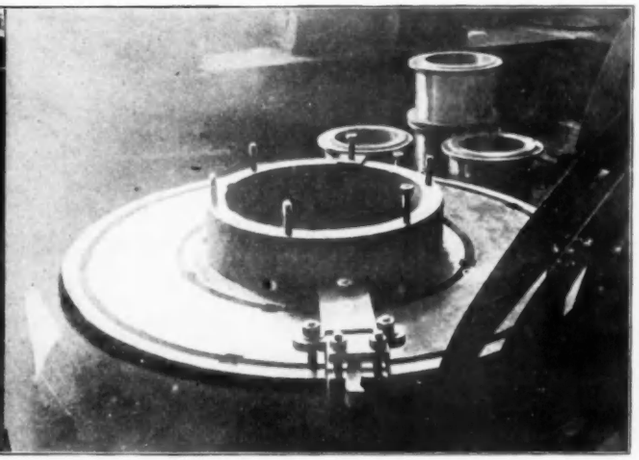


Fig. 12. BORING HEAD.

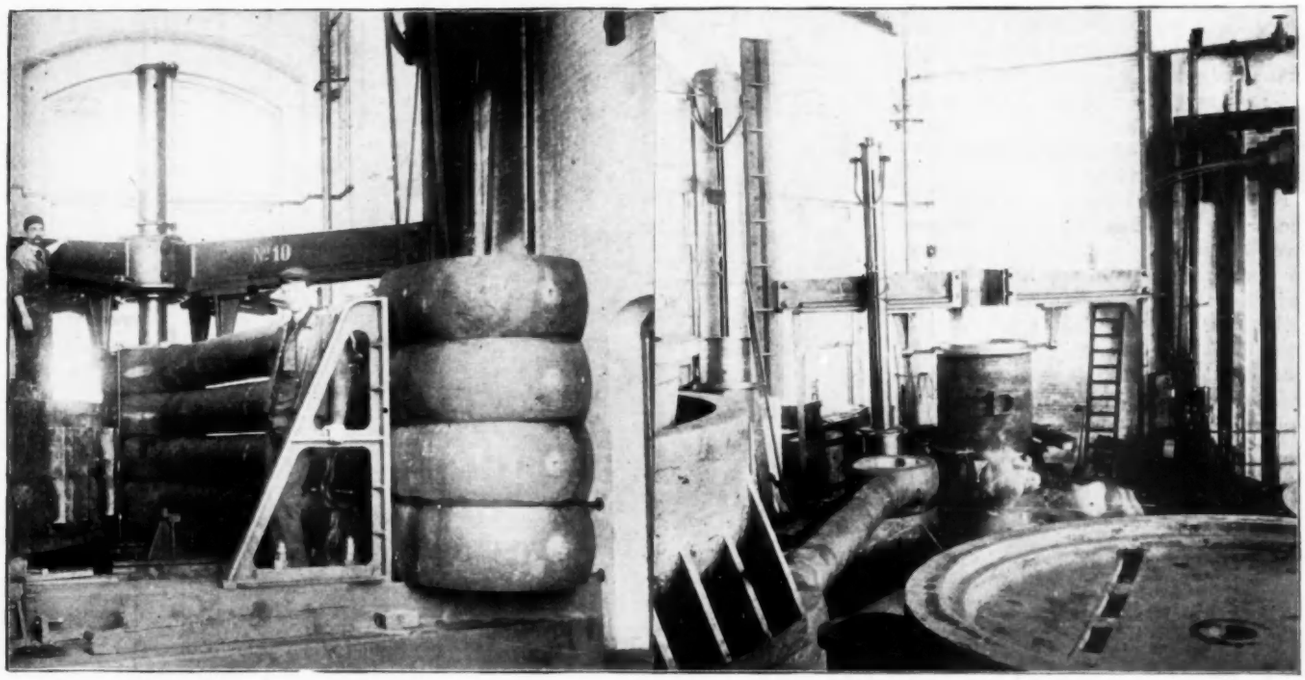


Fig. 13. BORING EYES OF FOUR LARGE CONNECTING RODS.

Fig. 14. BORING BARS REMOVED.

Vergne shops. The large cotton press cylinder weighed 35 tons with the riser, and there was considerable scheming done to enable the 15-ton crane to handle it to place.

The top fastening for work in a boring mill should be substantial and readily adjustable, and should also leave the entire face end edges of the top flange free to be acted upon by cutting tools. Figs. 8, 10 and 13 show the four brackets, adjustably secured to the underside of the crosshead and bracket-arms by bolts sliding in T-grooves, clearly exhibited in Figs. 13 and 10. Such a tool as this big boring mill, handy and of great range and capacity, does not often stand still in a busy shop under good management, and this one at the De La Vergne shops is applied to a great variety of odd jobs when it has no cylinder boring to do. Thus, in Fig. 13 it is shown boring the eyes of four large solid steel rods, each weighing about 13 tons; the bodies of these rods are 15⅞ inches diameter; the eyes are 25¼ inches diameter of bore, and 40 inches diameter outside by 16½ inches thick, and the length is 248½ inches center to center. A single cut through the pile of four rods, 66 inches deep, requires ten hours.

In the drawings, Figs. 1 and 2 (published last week), a 1 horse-power electric motor is shown placed to drive worm-geared crosshead adjusting screws. The screws and electric motor are not in place, and may never be added. The crane is required to handle both the work and the boring bars, and is used to raise and lower the crosshead as well.

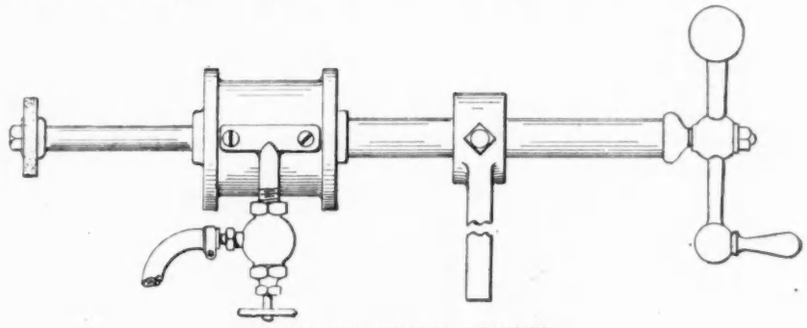
This extended description and the numerous engravings of this machine are given because machine tools of this type are comparatively rare, and it is of great assistance to a designer contemplating such a construction to have a full exposition of recent and successful practice in a case like the present, where personal inspection is not to be had except by a considerable expenditure of time and money, and I feel certain that many readers will feel thankful to the management of the De La Vergne shop for kindly furnishing drawings and the fullest information for publication.

H. L. ARNOLD.

▲ ▲ ▲

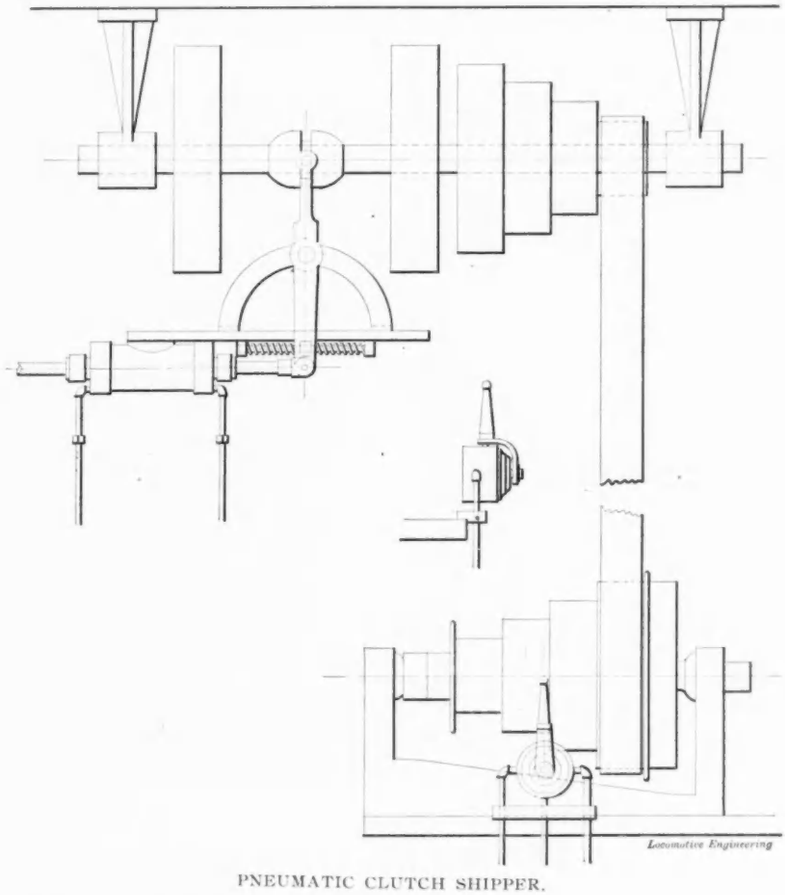
Some Practical Examples of the Use of Compressed Air in Machine Shops—A Belt Shifter, Center Grinder, Bolt Cutter.

The air brake was not only an important and valuable invention in itself, but it is proving itself a remarkably revolutionizing invention, and that not so much in itself and directly, as it is incidentally and by indirection. The air brake involves the air compressor, or, as they call it in the railroad shops, the air-brake pump, and the presence of the air-brake pump in the railroad shops is making those shops the instructors and the pioneers in the use of air. The ready means of procuring a constant supply of compressed air is leading to the adoption of the air for a great number of purposes in every railroad shop. Every issue of every railroad journal contains some new device to be operated by compressed air, and every device, as soon as the sketch of it is seen by the general machinist, is at once recognized as self-evidently desirable and inevitably successful. That the air-brake pump has done absolutely nothing but furnish the opportunity and called the attention of the enterprising mechanic is evident enough from the fact that the railroad shops, as fast as they are able to accomplish it, are discarding the air-brake pumps and putting in standard air compressors as part of their permanent equipment. The air-brake pump, except for the peculiar conditions of service imposed by the air brake, is about the worst air compressor known; and yet even with its aid the compressed-air service has developed with wonderful rapidity in the railroad shop.



PNEUMATIC CENTER GRINDER.

In this connection we may bring to the notice of our readers three distinct and separate applications of compressed air to machine shop use that appeared in the last issue of "Locomotive Engineering," and we may well ask why should not such applications of the air be developing and establishing themselves in other machine shops as well as in railroad shops? The only answer is, that they are not in use in every shop because the air supply is not established in every shop. We believe that the use of the air must inevitably become general, and that it is



PNEUMATIC CLUTCH SHIPPER.

better to adopt it soon and get the advantage of superior facilities, than to adopt it later in self-defense and to bring us up to the full efficiency of those who have been more enterprising.

All the pneumatic devices demand, first of all, the established air supply. When that is established and maintained, the rest inevitably follows. With an air supply at hand, it is impossible to keep the air hoist out of the shop, and then the other devices follow.

The devices illustrated require little explanation. The center grinder is fastened on the tool post, the hose is connected to a nozzle near, you turn on the air and you grind the center, and that is all there is of it. There is a rotary air motor with a cylinder 2 inches diameter, in which revolves a two-wing piston with ¼-inch eccentricity. The emery wheel at the end of the spindle is 1½ inches diameter and ¼ inch thick. The hand crank at the right moves it back and forth longitudinally over the conical surface of the center. This was got up by Mr. J. W. Porter, chief of the tool department of the Wisconsin Central shops, Waukesha, Wis.

The next device illustrated is a pneumatic clutch shipper for a lathe countershaft. This also is from the Waukesha shops, the drawing for it having been furnished by Mr. James McNaughton, superintendent of motive power. An air cylinder is placed near the countershaft to be operated; the normal position of the piston is in the middle of the cylinder, it being held there by the springs connected with the shipper lever. Admission of air pressure to one end of the cylinder moves the piston and shipper in one direction, and air pressure in the other end of the cylinder moves the shipper in the other direction, while a release of pressure allows the shipper to return to the central and inoperative position. The operating valve is placed in front of the head-stock of the lathe, or, in case of other machines, wherever may be most convenient for the hand of the operator. In screw-cutting on the lathe, it will be readily seen how neatly and quickly the countershaft can be reversed, or stopped, or started in either direction. The pipes may be carried from the valve up to the shipper in any way most convenient.

The bolt-cutter arrangement, which is the third device here shown, is from the Pennsylvania Railroad shops at Jersey City, and is the invention of Mr. H. A. Ferguson, assistant master mechanic of

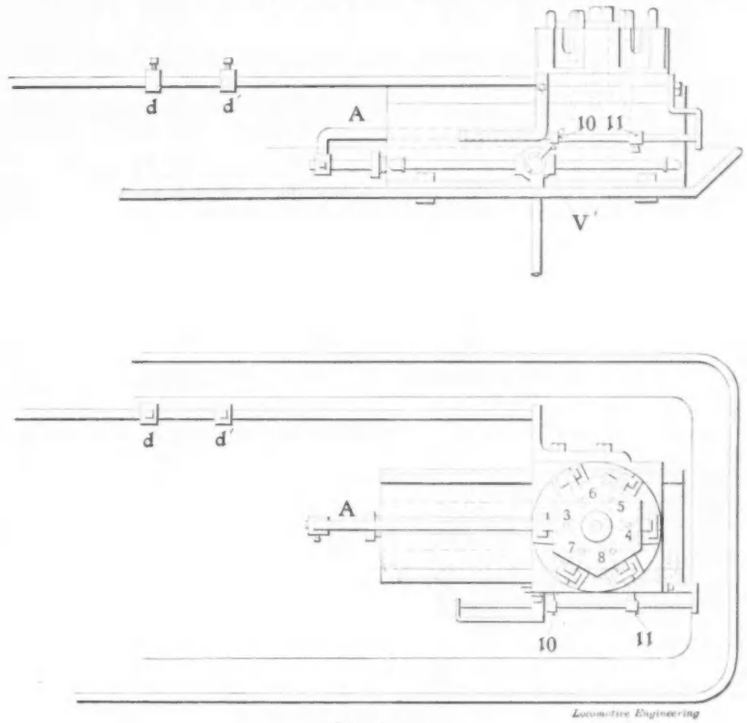


Fig. 1

BOLT CUTTER OPERATED BY COMPRESSED AIR.

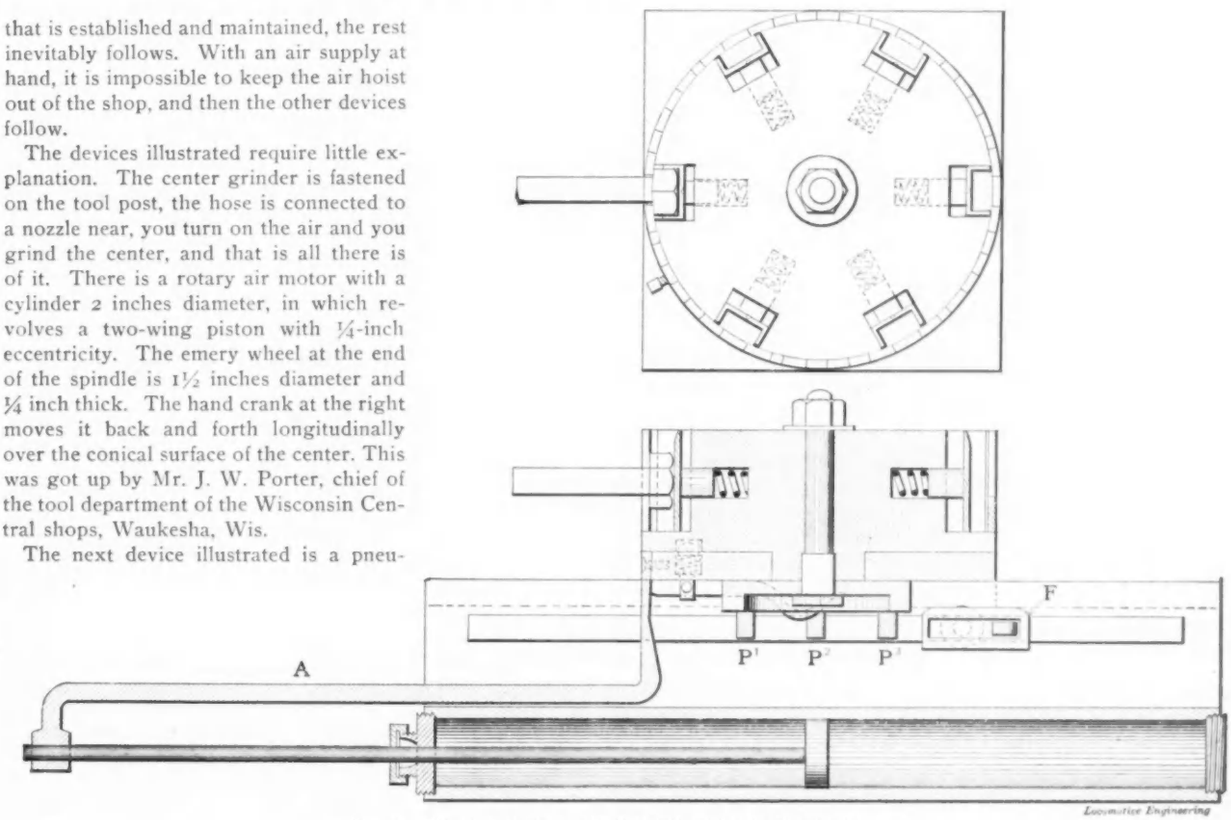


Fig. 2. BOLT CUTTER OPERATED BY COMPRESSED AIR.

the Meadows shops. It was first applied to an old bolt cutter, and had cut several hundred bolts before it was exhibited to anyone. The principal part of the apparatus is a revolving turret with sockets for six bolt heads, which are successively held in correct alignment with the center of the thread-cutting dies. A small cylinder is located under the turret, and in this the compressed air operates to turn the turret, the admission of air taking place automatically, being governed by the longitudinal travel of the turret while the thread is being cut. The tappets 10 and 11, Fig. 1, are set to engage with the valve handle N^1 at the proper time to move the air piston and the arm which it carries, and forcing the turret back to position ready for the next bolt. While the turret is being carried back, the pins P^1, P^2, P^3, projecting from the under side of the turret, encounter a pawl, F, Fig. 2, which turns the turret one-sixth of a revolution and brings another bolt in line with the dies. While the turret is revolving, the body of the bolt previously threaded is carried up an inclined plane, not shown in the cut, and thrown by centrifugal force into a receptacle provided to receive it. The air attachment, it will be seen, first, forces the turret with its bolt up to the die; second, moves the turret back to its first position after the thread is cut; third, rotates the turret, bringing a new blank into position for the dies; fourth, ejects the bolt after the thread is cut. The operator has only to keep the turret supplied with blanks. The dies open and close by the familiar mechanism found on bolt cutters, by means of the tappets d and d^1.

The above devices are only typical of those which are constantly coming into use wherever an air supply is maintained. They are numbered by the hundred, and they have no more right to be in railroad shops than in other shops, and there is no reason for their being found there except that the compressed air is there.

ELECTRICAL MACHINERY.

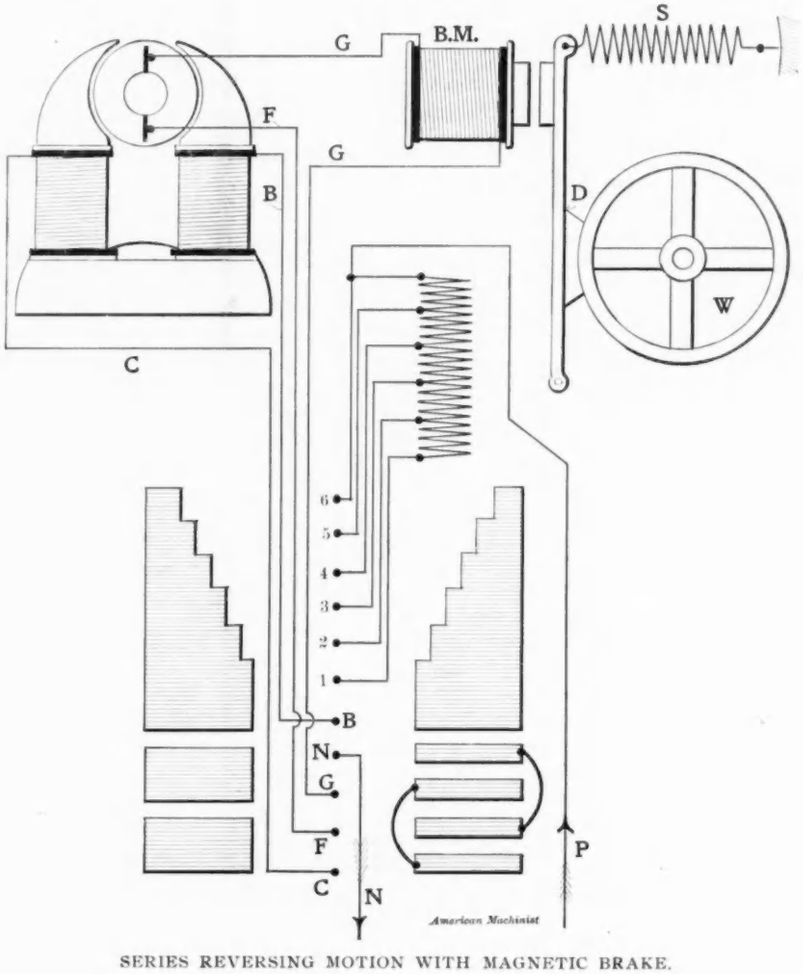
Reversing Motors with Magnetic Brake.

BY WM. BAXTER, JR.

In many cases where reversing motors are used, it is desirable to have them so arranged that they may be held when the current is turned off, so that they cannot rotate, even if the force tending to set them in motion is very considerable. In other cases, where the work performed is of such a character that all the operations must be accomplished in the shortest possible time, the slowness with which the motor would stop, of its own accord, would not be in harmony with the rapidity of action which the conditions of the case render imperative.

Among cases of the first kind, where the motor must be held against the rotating effort of the load, may be mentioned simple hoisting machines of all kinds. Of the cases where a quick stop must be made, a striking example is that of iron rolling mills. Motors are used very extensively, in this line of work, to operate the feed tables, and as the blooms must be handled while they are hot, all the operations have to be made with the least possible loss of time. Not only is it necessary to save time so that the iron may cool off as little as possible while being rolled, but, also, because the men are paid for their services by the ton, and therefore desire to lose no more time than is actually necessary. It is perfectly feasible to arrange a hand brake so that it can be used to effect a quick stop, but such a device is, at the best, only a make-shift when compared with a properly constructed magnetic brake.

The disadvantages of a hand brake are numerous; among the most striking may be mentioned, that it is not possible to actuate them in unison with the motor—that is, the brake will be put on either too soon or too late. If it is applied too soon the effect will be to waste energy, as the current passing through the motor will be expended in overcoming its resistance, caused by the premature application of the brake; if it is applied too late there will be a loss of time in bringing the machinery to a state of rest. If a magnetic brake is used it can be so arranged that it will be under the control of the same switch that operates the motor, and therefore it can be timed with such certainty that it will begin to act the instant the current is turned off the motor. In this way there will not be any unnecessary loss of energy by the bucking of the motor against the brake, and neither will there be a loss of time by a failure of the brake to begin to act on time. In addition to the foregoing advantages, the magnetic brake is not dependent upon the strength of the operator, and this amounts to more than it would appear to at first sight. The leverage of the hand brake can be so proportioned that the effort required to operate it will be small; but even then it will not be absolutely reliable. The magnetic brake renders the work of operating the motor far less laborious, as all the operations of stopping and reversing and putting on the



SERIES REVERSING MOTION WITH MAGNETIC BRAKE.

brake are accomplished by the movement of a single lever, and a very small one at that.

The accompanying diagram shows how the magnetic brake is applied to a series-wound motor, and also the manner in which it is connected with the circuit wires. When used in connection with a shunt motor the wiring is substantially the same; the only point to be observed is that the magnet *B M* must be in the armature circuit. In the arrangement shown in the diagram the connections are such that the current is turned on to the brake when the motor is running, and is turned off when it is stopped; and the spring *S* is used to apply the brake. This order may be reversed, and the spring may be used to hold the brake off, and the current to put it on; but this arrangement would not be so good. In the plan shown in the diagram, if anything should go wrong with the brake magnet, it would simply fail to lift the shoe *D*, and as the increased resistance would cause the motor cut-out to act, the difficulty would at once be detected and remedied; but with the contrary arrangement, the effect would be that the brake would fail to act, and under certain conditions this might cause serious trouble.

The manner in which the operation of the switch connects the motor terminals with the line wires, as well as the changes in the path of the current through the rheostat, by the progressive movement of the switch handle, will not be explained here, as all this was fully described in the articles on the series and the shunt reversing motors published in the issues of September 24th and October 1st of this journal. In this connection, only that part that refers to the action of the brake will be considered.

The explanation of the diagram is as follows: *W* represents a brake wheel which may be located on the motor shaft or on that of the machine, *D* represents a brake shoe, and *S* a spring or its equivalent. When the motor is stopped, the shoe is pressed tightly against the wheel by the force of the spring; but as soon as the current is turned on, the brake magnet *B M* becomes energized, and, pulling against the spring, raises the shoe. From this it will be seen that as long as the motor is running, the brake is held off by the magnet; but as soon as the current stops, the magnet loses its strength and the brake goes on. In the diagram, the brake magnet coil is shown connected with, and as part of the *G* wire, but it can be connected with either of the four wires that run to the motor; that is, in a series machine, which is the type shown in the diagram. With a shunt motor it would have to be connected with one of the armature wires. By tracing out the current in the diagram it will be found that the *P* wire leads through the rheostat to the contact 1, which, when the switch is turned, is connected with *B*, which latter conveys the current to the field, from whence it returns by the wire *C* and goes to wire *F*, and through the armature to wire *G* and the brake magnet, and thence to wire *N*.

This arrangement of brake, in an elaborated form, is used in connection with electric elevators. It is also used, more or less modified, with motors that are not provided with a reversing switch, either to hold the load or effect a quick stop.

▲ ▲ ▲

Planing Machine with Electric Motor.

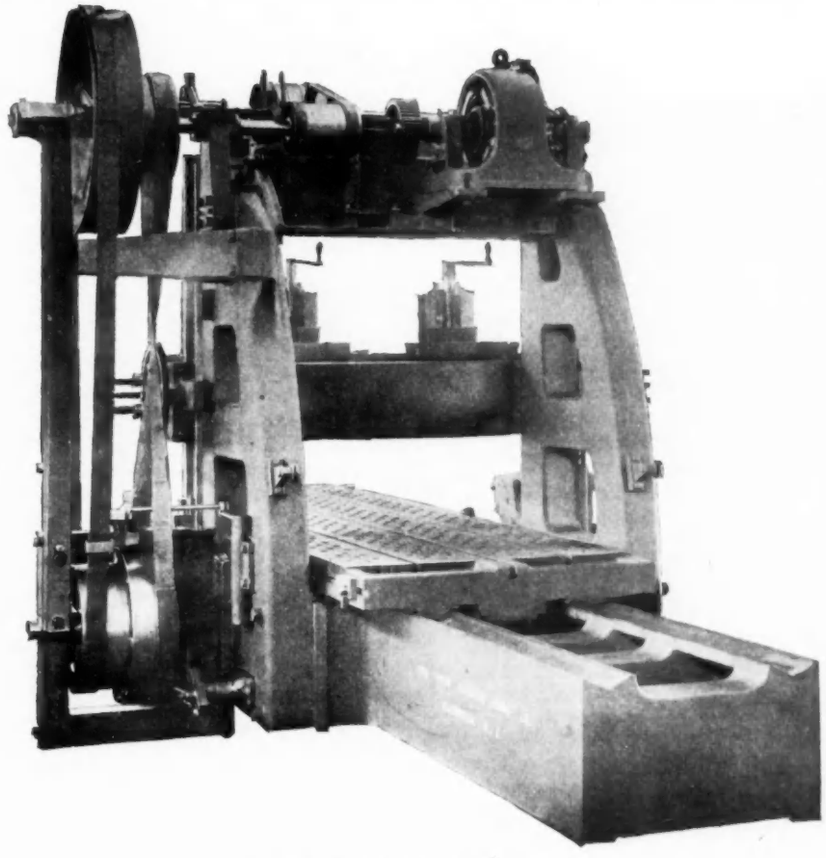
The Homestead works of the Carnegie Steel Company have more electric motors in service than any similar plant with which we are acquainted—the total number aggregating over four hundred. These motors are used for a great variety of purposes, superseding in some cases small steam engines, and in others taking the place of shafts and belting. All of the newer heavy machine tools and many of the old ones are now driven in this way. The results of motor driving have been so satisfactory that the definite policy of using them in all cases where suitable has been adopted, and in particular all future heavy machine tools will be driven in this way.

Heretofore the motors have been belted to the tools without change in the latter, the motor being placed upon a bracket bolted to the nearest convenient post or wall; but with tools bought with this method of driving decided upon beforehand, it becomes a natural step to so attach the motor to the tool as to make them in effect one machine.

We illustrate herewith the first machine bought in pursuance of this policy—a 60-inch square Pond planer which has just been shipped.

It will be seen that the countershaft is removed from its usual position and is mounted upon the housing tie piece, where it is driven by a direct gear connection with the motor shaft—the motor being mounted upon brackets bolted to the tie piece. The short horizontal belts leading from the countershaft operate the elevating screws of the cross-rail.

The motor is a Westinghouse 15 horse-power four-pole compound-wound machine. The use of compound-wound motors for work in which the resistance is subject to sudden variations has now come to be the regular practice. The reasons for this were very fully gone into in our issue of May 14th. The motor is wound for a pressure of 220 volts, and its speed is 1,150 revolutions per minute. The pinion upon the motor shaft is of raw hide.



PLANER WITH ELECTRIC MOTOR.

The planer is to be placed in the repair shop—a department of the works which has previously had fewer motors placed in it than almost any other. It will stand in the runway under the traveling crane, where there is now more room than is required for erection, while the space available along the

sides of this runway is becoming well occupied. It will be noticed that a planer with the usual detached overhead countershaft could not be placed in this location at all, but that arranged as this is, the entire machine is self-contained and may be placed wherever convenient.

▲ ▲ ▲

Letters from Practical Men.

Corrugated Steam Jackets for Engine Cylinders.

Editor American Machinist:

In my letter of August 6th, commenting on the steam economy of the Belgian engine, I referred to Mr. Druitt Halpin's method of forming the outer surface of the jacket, on which Mr. Halpin comments below. Others of my friends besides Harris Tabor think, if we are to improve our engine practice, it will not be done by learning from abroad, and I am sure I do not know as it will, but believe there is no harm in knowing, and giving the same consideration to what they do that we would to the work of our own engineers.

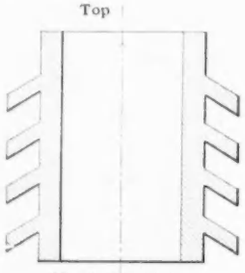
JOHN E. SWEET.

"Prof. John E. Sweet:

"Dear Sir—In the 'American Machinist' of August 6th you kindly refer to my system of jacketing, in your article on the Bollinckx engine. I certainly should not look for increased transfer of heat from the arrangement Mr. Bollinckx has adopted. My arrangement is this, by which a proper proportion is made between heat receiving surface and heat transfer surface:

Horizontal Cylinder

"In the tests Professor Unwin was good enough to make for me, it was shown that 3.28 times more heat was transmitted by my system than from plain jackets; and as I am clear in my own mind about the deposition of water in the jackets of vertical engines, I make the ribs like this:



Vertical Cylinder

"Professor Nicolson, of the McGill University, Montreal, has written a paper describing tests on an engine in which some of the cylinders are jacketed in this way. This will be read before the Institute of Mechanical Engineers, in London, and will be very fully illustrated. I think it would interest you to look into this paper when it is published.

"DRUITT HALPIN,

"17 Victoria st., Westminster, London, S. W."

▲ ▲ ▲

Power Tests Versus Time Tests.

Editor American Machinist:

It is rather astonishing to me that in these days we hear so much about power tests and so little about time tests. Especially when it is a test of machine tools the latter would seem to be vastly the more important. Power is really one of the cheapest things that we have to do with—at least in machine work. It is often so cheap in comparison with other items that it is not even worth saving.

A very practical illustration will serve to provoke our thoughts a little. I have in mind a machinery manufacturing establishment whose annual operating expenses may be summarized as follows: Pay-roll, 200 men, $2 per day, 300 days, $120,000; castings, forgings and all materials (they have no foundry),, $120,000; power, $4,000; all other expenses, $56,000; total, $300,000; selling value of output, $400,000.

The power cost, as I have given it, I know to be very high, but as it stands it is only 1⅓ per cent. of the total operating expenses, and I am very much inclined to think that one per cent. will cover the power cost in many machine building establishments, especially large ones. Now, if we could increase our output by increasing the power employed, we could afford to give a great deal more power for a little more product. Say that by doubling the power used we could increase the efficiency of the men only 10 per cent., it would be a very profitable investment.

Using double the power and increasing the output 10 per cent., without increasing the pay-roll, our case would stand something like this (doubling the actual power used would not double the cost of it): Wages, $120,000; material, $132,000; power, $7,000; other expenses, $61,000; total, $320,000; value of output, $440,000. Here we get $40,000 for $3,000, which would seem to be a pretty good investment if it were possible, which it generally is not, in machine work.

There is more than usual attention being given at the present time to testing the power required to drive machine tools, and I cannot help thinking that we are missing our opportunity. The drums may beat as loud when the troops are only "marking time" as when they are doing the liveliest marching, but only the marching counts. In the "American Machinist," August 20th, we had a paper about a hydraulic dynamometer, with a lot of indicator cards showing the power required to drive different machine tools under different conditions. The article was to me an extremely interesting one, as I have no doubt it was to many other readers. The diagrams seemed to tell us a great deal about the operation of machine tools and the power required to drive them; but the more I think of it, the more it seems to me that it told us actually nothing of what we want to know. It showed that a drill as it becomes dull takes more power to drive it, that an eccentric milling cutter does not require a uniform drive for the whole revolution, and that cutting steel takes more power than cutting cast iron, which is like telling us that the Dutch have taken Holland. If the article carried any hint to anybody of how any machine could be made to do more work, or whether any machine would do more or less work under any change of conditions, I have failed to find it.

No machinist needs to be told that, in running a lathe or a planer, the most important thing, as affecting the results accomplished, is the shape and sharpness and adjustment of the cutting tool. Any power tests of machine tools that do not give the fullest information about the cutting tool used simply omit the most important factor, and are therefore worthless, or nearly so. They illustrate what is often said about the difference between theory and practice. Theory often fails by reason of its incompleteness, by its omission in its computations of some weighty factor, and many pretentious tests are valueless, if not misleading, for the same reason.

I am by no means disposed to undervalue the power tests of machine tools if intelligently conducted. With the cutting tool and the particulars pertaining to it assigned their proper weight and recognition in the tests, they might lead to instructive and valuable results. If every other condition remains unchanged, and one cutting tool, or merely some special setting or adjustment of a cutting tool, will show that less power is required than for some other style of tool, or some other adjustment of it, to do a certain amount of work, say to make a certain weight of chips, or to get over a given area with a finishing cut, the presumption will be that the condition requiring the least power will permit an increase of speed over the other conditions.

But we may abandon our power tests entirely, with the more or less elaborate and costly apparatus involved, and the care as to every detail, and go into tests involving the time of accomplishment alone, without any apparatus but a watch or a clock, and without any care as to any particular, except to see that the work is done right, and we can learn vastly more by the time test alone than by the power test alone. The time test is the practical test that is in continual operation in every shop that makes any progress, and it is this time test which is continually driving us toward the adoption of improved means and methods. If any man anywhere will turn out ten per cent. more work than

any other man, there is not a machine-shop proprietor in all the land who will thank you for telling him how much power was required to do it.

It is to be remembered that the power tests of machine tools are in some respects peculiar, and essentially different from such tests as, for instance, those of a pumping engine or the speed trials of a ship. In such tests the work done cannot be eliminated from the statement of the trial—there is always so much water lifted or so many miles traversed; but with tests of machine tools it seems to be quite possible to ignore the results accomplished. It is not only possible, but it seems to be actually the practice in too many cases.

TECUMSEH SWIFT.

▲ ▲ ▲

Testing Hardness of Metals.

Editor American Machinist:

The article on "Testing Metals for Hardness" in your issue of September 17th is of considerable interest, the subject being somewhat uncommon, and the method perhaps satisfactory, giving results that may be compared. But I wonder if it is not a matter of some skill to determine just when the two cylinders indent each other?

I would like to call attention to the Government method in use at the Watertown Arsenal (see Reports of Tests at Watertown Arsenal for 1884), for perhaps their hardness test may not be familiar to many readers. It is done by indenting a smooth surface of the metal with a hardened steel tool of standard pyramidal shape. (See drawing.)

Assuming the volume of metal displaced by the tool under a fixed load to be inversely as the hardness of the specimen, this hardness varies with the reciprocal of the cube of the length of any of the bounding lines of the indentation.

The Government test used a fixed load of 10,000 pounds for ordinarily hard metals, and 4,400 pounds for aluminum and its alloys, and the computations were made as follows:

The volume displaced when the long diameter of indentation is 1 inch, is $3\frac{1}{3}$ cubic tenths of an inch; 3.333 +, then, was called the hardness shown by that indentation, and, in general,

$$\text{hardness} = \frac{3.333}{l^3},$$ l being length of longest diameter of indentation in inches.

Not long since I had occasion, in company with another man, to make a series of tests on aluminum alloys. The drawing is of the tool as we made it, and the photo shows tools and indentations. The results by this method are reliable, I think, for the vital feature of comparative tests is easy, namely, the exact duplication of method and conditions. Quite small differences of hardness may be shown if the surface of the metal is true and smooth and fine measuring appliances are at hand. Of course, the tool must be made with accuracy.

STEPHEN R. LEONARD.

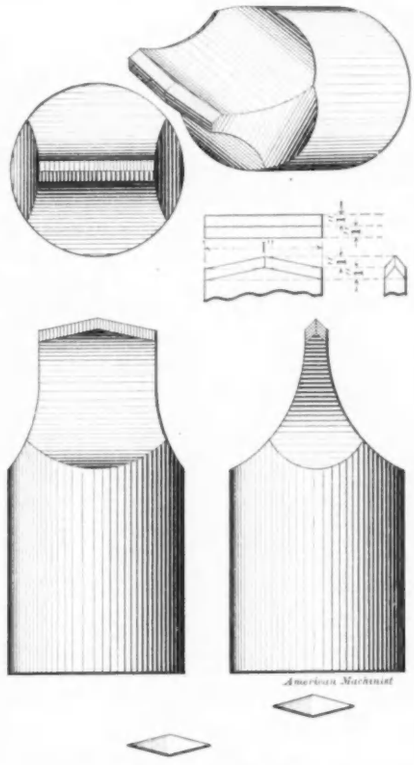
Kenwood, N. Y.

▲ ▲ ▲

Chinese Language and Other Obstacles to Advancement in China.

Editor American Machinist:

I note your article (September 3, 1896, page 33) on the Chinese language as one of the greatest obstacles to the extensive introduction of railroads and telegraph lines in China. If you can afford your valuable space, I would like to give a comment upon that obstacle. If other obstacle, were no greater, there would be some hope for the immediate and substantial advancement of China; not that this



TESTING TOOLS AND INDENTATIONS.

obstacle is not great, but that there are many greater.

That the language has been no great obstacle to telegraph lines is demonstrated by the extension of lines into every province in China, since the central government dropped enough of its conservatism to tear down other and greater obstacles. Commercial as well as government messages have given the language a practical test during the past decade, and no great objections have been found, in its use, through the wire. The want of more extensive use of the telegraph is due to other conditions than China's rude language.

There is no doubt that a better system of telegraphy than the present can be devised for China; but the present system will not hinder if other conditions favor the introduction of railroads. It is true there are forty thousand idiographic characters in the Chinese language, and it is impossible to make a telegraphic alphabet. Out of these forty thousand the present system (invented by a Frenchman) has selected about six thousand for use, and they are numbered for telegraphic transmission. Out of these six thousand one thousand of the commonest characters or words have been found all-sufficient for government and commercial messages; both within the empire, and also from Chinese embassies and merchants abroad. The most important parts of government messages, even memorials to the Emperor, are not written in the decorative and obsolete language of the literati, but in the common and practical language of the merchant. The wording and expressions of these messages are such that all can be conveniently encompassed within the one thousand numbered words. The government messages are almost always written by some under-secretary or clerk of no special literary merit, and the official signing them only takes the responsibility. Most of the Chinese merchants are men of comparatively no schooling, but their written language is as simple as it is to the point; and to this language the literati resort when they wish to write a business letter or transmit common thoughts. So, men of ordinary intelligence, such as would be selected for engine drivers and train conductors, would certainly know enough of the written language as to more than cover the use of the one thousand words in telegraphic use. Or, should it be found necessary, every candidate for such positions can easily memorize that thousand words within one Christian weeks's time; for all Chinese school children in their first half year memorize their second reader, a book of one thousand different words. Take the Chinese laundrymen: Most of them are laborers of the lowest order, and who have had not a day of schooling at all—if anyone will write one of them a letter in commercial Chinese, he will write a reply the meaning of which is unmistakable.

I hope I have made it plain by the above, that it is not necessary to man the future Chinese train with literati. As a matter of fact, the employés of the present telegraph system are young natives who have received English education in schools in China or Hong Kong. They may belong to the families of the literati, but they have received nothing more than an ordinary education, and are not literary by profession.

Should the Chinese language be found too rude and, with its forty thousand characters, insufficient for railroad use, as it is unmistakably so for the introduction of Western education, it will be no more of an obstacle to use English for

the former (as it is now, and will be in the future), than for the latter. One who has not been in China would be surprised to find the number of English-speaking natives, especially among the younger men, and those who murder the queen's English need not be counted, either. Considering the employment of foreigners in the Chinese service, we can look at the officers of all Chinese merchant vessels, and also of the maritime Customs, from Sir Robt. Hart down to the inspector who confiscates a basket of dried mushrooms or a new silk handkerchief on a vessel plying between Shanghai and Canton.

Among the greatest obstacles to the introduction of railroads are: The total absence of personal rights vested in a Chinese subject; the want of encouragement to natives to invest their money in government enterprise; the want of encouragement for natives to invest in incorporated enterprises, because of the want of proper protection from unjust taxation, extortion and seizure; the want of freedom of the press; the indifference of the government to progress and reform; and the general rottenness of the government. These are obstacles not so easily surmountable as that of their language. To be more explicit, let me give an example: During the late war with Japan the government asked its subjects to subscribe to a loan, and some responded liberally. After the war that loan was repudiated, and its subscribers were paid with empty titles, such as can be bought with money. Practically all newspapers in China are under foreign protection, and the only one not so protected, which was located in Canton by a Chinese, Americanized in ideas, was closed, and all its property and that of its proprietor confiscated, and all employés ran for their lives, in disguise, and the chief proprietor and editor died of a broken heart. Under such conditions it is scarcely expected that natives would scramble over each other to invest their savings in railroads whose concessions are given to Chinese subjects, and whose management and entire control are expected to be in the hands of their government.

J. LANDSING.

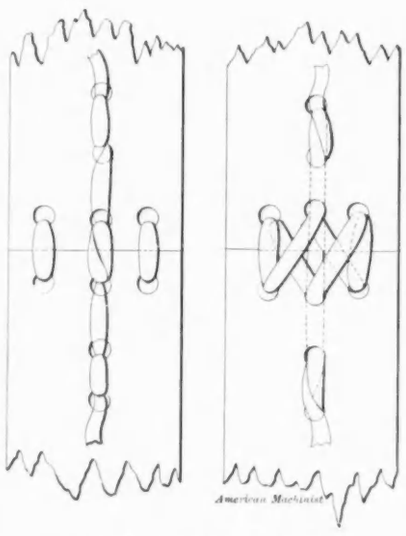
Nassau street, New York.

▲ ▲ ▲

A Method of Belt Lacing.

Editor American Machinist:

Some time ago (perhaps a year) I saw in your paper an article on how to lace a belt. I inclose two pieces of card laced with a piece of ribbon. What I wish to call attention to is the manner in which the ends of the lace are fastened. Until I ran across this fastening I had much trouble in making the ends hold. I tried all the ways of fastening that I had ever heard of or seen, without much success; they would all of them sometimes pull out; but although I have used this for five or six years, I have never known it to fail.



A METHOD OF BELT LACING.

The lace of the belt may break, but the end will be found to be fast.

FRANK P. MILLER.

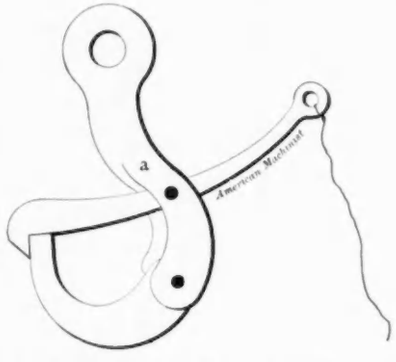
Brooklyn, N. Y.

▲ ▲ ▲

Another Trip for a Foundry Drop.

Editor American Machinist:

In the "American Machinist" of June 18th and July 2d I saw sketches of trips for foundry drops. As I have read a good many articles from Mr. Tecumseh Swift, this gentleman stands high in my estimation; therefore I would have adopted his idea of a trip, like sketch in "American Machinist" No. 27; but here comes the "invisible cost racket," and that is the reason I made one after my own idea, and take the liberty of sending you this sketch of it. It is simplicity itself; any common blacksmith can forge it, and it works like a charm.



ANOTHER TRIP FOR FOUNDRY DROPS.

JOHN FRANK.

Evansville, Ind.

The Economy of Corliss Engines.

Editor American Machinist:

Your interesting editorial on the subject above named, October 1st issue, is none the less interesting because I cannot quite agree with all its conclusions, but, on the contrary, rather more so. It has always appeared to me, from early observation, that the rapid progress of the Corliss engine was very largely due to the fact that Mr. Corliss did the work with a comparatively small cylinder better and cheaper than it was being done with a large one, notwithstanding the fact that his construction in the majority of instances called for a cylinder too large for the highest economy.

My experience has been such as to lead to a rather firm belief that, taking automatic engines, large and small, just as they are running to-day for manufacturing purposes, nineteen are wasting steam because of being underloaded—cylinders too large—for every one that is running uneconomically from overloading. This may appear like a strong statement, but I believe I could go further and still be within the limit.

I have built some high-grade automatic engines, and whenever trouble has arisen as to size, it has invariably been because a customer wanted to contract for a larger engine than he needed. In fact, when the matter was left to my own judgment I remember but one engine that was too small for economical working, and the trouble then was because the steam pressure promised was not furnished. I do remember of building them so large that I should not have been willing to submit them to a test for economy.

Just now there comes to mind an incident of twenty years ago. I was called upon to examine two automatic engines, both belonging to one firm. These engines had been in use for at least ten years. One of them was rated at 100 and the other at 150 horse-power. The cylinder proportions of either engine were ample. Gradually work had been added, until both engines were believed to be too small for their work; they failed to do it satisfactorily, and it had been about decided that larger ones must be substituted. The application of the indicator showed that the smaller engine was never called upon for more than 67 horse-power, nor the larger one for more than 110. The work of a half day sufficed to put both engines in the condition of being too large for their work.

In regard to Corliss engines not being able to do their work at poor economy, that may be true enough if by poor economy late cut-off is always in reference; but it is quite as true that hundreds of Corliss engines are running at poor economy from too early cut-off. Personally, I have had literally hundreds of diagrams from Corliss engines sent me by stationary engineers for an opinion, and I venture

to say that of the whole not ten showed late enough cut-off for the best results. The same would have, of course, been true of any other type of engine.

It is easy enough to find Corliss engines that have been in use for years driving roll trains, that would invariably drop down to full stroke during the first pass or two, gradually pulling themselves up as the work became lighter, until the cut-off would be quite too early. This stringing-out of the cut-off between that too early and none at all, except that due to the lap of the valve, the stringing-out being mostly a jump, is, of course, not to be commended, although I have no doubt there are instances where, measured by economy of steam consumption, it would show a saving.

As occasion has, before this, been taken to remark, in effect at least, Mr. Corliss had the habit of stating to a prospective customer that an engine of, say, 200 horse-power would require the burning of so many pounds of coal per day, and not that an engine of the dimensions given would require the burning of so many pounds of coal per horse-power. The difference between the two statements is apparent, and I have no doubt, had a good deal to do with the continued success of the undoubtedly great steam engine builder, whose efforts it was always easier to put down by the logic of the pen than by the logic of actual occurrence.

In my opinion we should look elsewhere than to the fact that the construction calls for a cylinder of large dimensions, since cut-off must be early if at all, for the reason for the success of the Corliss engine—in fact, I should be entirely inclined to say that its success was in spite of this drawback—all of which is, of course, only a matter of opinion.

F. F. HEMENWAY.

[In miscellaneous practice there is no doubt a tendency among purchasers to call for unnecessarily large engines. The reputation of the Corliss engine was, however, established in the cotton mills of New England, under circumstances which rendered it easy to determine the exact load. With his system of guarantees it is not likely that Mr. Corliss left much to guesswork, or that he provided a greater margin of safety than was prudent. Under these circumstances we still think the position taken in our editorial is sound.—Ed.]

▲ ▲ ▲

To Bore a Hole, Centered and Square, Through a Cylindrical Piece.

Editor American Machinist:

Nearly all of us at some time in our experience have occasion to bore a hole sideways through a cylindrical piece of steel, where it is quite important that said hole shall be exactly centered and shall pass through exactly square, *i. e.*, at right angles to the center line of the piece. That is to say, we sometimes want to do this within a smaller limit of error than is possible on the drill press.

I show by the sketch a method of doing this which was shown to me by a friend of mine, who suggested that it might interest your readers, as I hope it will.

The special tool required for the job is an angle plate to be fastened to the lathe face-plate in the usual manner. This angle plate has two V-grooves in its upper surface which cross each other exactly at right angles and are precisely alike—same form and same depth. The piece of work is first placed in the groove which is in line with the lathe spindle, as shown at Fig. 1. One end of the work is left to project beyond the plate sufficiently to apply an indicator to it and make it run dead true. The work is then simply changed to the other groove, as shown at Fig. 2 and the hole bored.

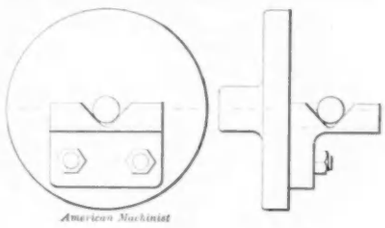


Fig. 1 Fig. 2

A JOB OF BORING.

Of course, it is evident that the plate must be very nicely made; but this can be done by a little care. I once heard of a man who called himself a tool-maker, and who, in using one of these plates for the first time, used tissue paper to pack up the work and make it run true; but I think none of your readers will make such a mistake as that.

F. J. WOODHURST.

▲ ▲ ▲

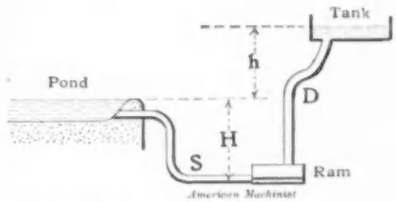
Efficiency of Hydraulic Rams.

Editor American Machinist:

In a late issue of your paper, Mr. Chandler asks for an opinion as to what is the correct expression for the efficiency of an hydraulic ram. According to Rankine, Mr. Chandler's first expression is correct, and perhaps the following explanations will make it clear. Before going farther, however, it is necessary to point out that efficiency is the useful work done divided by the work expended, and the useful work in this case evidently consists of lifting water above the source of supply, not above the ram, and therefore Mr. Chandler's expression cannot be correct.

Let Q be the pounds of water flowing per second from pond to ram, and q be the pounds per second lifted to the tank: Then $Q - q$ are the pounds per second flowing to waste.

Suppose the quantities $Q - q$ and q flowing at the same time, but separately, along the supply pipe S to the ram. Now, the quantity q, in falling through the height H, acquires sufficient energy to raise itself through the height H in the delivery pipe D; but we know that it is then raised further through a height h to the tank, an amount of work $q\ h$ being consumed in the operation. It will



EFFICIENCY OF HYDRAULIC RAMS.

be noticed that this is useful work. It will also be seen that this work must have been performed by the quantity of water $(Q - q)$ falling through the height H, and we have:

$$\text{Efficiency} = \frac{\text{useful work}}{\text{work expended}} = \frac{q\ h}{(Q - q)\ H}.$$

Another explanation, given by a friend, is perhaps clearer: Suppose the ram replaced by a turbine driving a pump, the suction of which is connected to the supply pipe S just before it reaches the turbine: Then the pump will elevate the q pounds of water to the level of the pond without any help from the turbine on account of the head H, and in elevating q pounds to the tank, only $q\ h$ foot-pounds will be taken from the turbine. It is clear, however, that only $Q - q$ pounds of water reach the turbine, and that the work done by the water on the turbine is therefore $(Q - q)\ H$, and the efficiency $\frac{q\ h}{(Q - q)\ H}$, as before.

Still another way of looking at it is that $Q - q$ pounds of water, in losing an amount of potential energy represented by $(Q - q)\ H$, impart to a quantity of water q an increase of potential energy $q\ h$, and therefore the efficiency of the process is $\frac{q\ h}{(Q - q)\ H}$.

CHARLES P. PAULDING.

Calumet, Mich.

▲ ▲ ▲

Foundations for Machinery.

Editor American Machinist:

Foundations for machinery are important, and some in existence may not be uninteresting.

A lighting station was to be built alongside of a tide-water river. The land was composed of silt, or river mud, for a depth of 14 feet, and top of that were from 4 to 6 feet of sand and all kinds of debris that are usually found on all public dumps.

The engineer dug down nearly to the mud and put in his foundations. The engines were of the high-speed type, requiring a broad base foundation even on good ground. For these foundations he

put in a floor of concrete, and then built up straight piers, putting in about two-thirds of the foundation called for by the engine builder. This is shown in Fig. 1. In this sketch, *A* is the engine; *B*, foundation; *C*, wall of building; *D*, a retaining wall. When objections were made to his small foundations, he put in some I-beams from the engine pier to the wall of building and retaining walls, and built in brick as shown at *E*. The vertical pier *B* was shaky, as would be expected. The floor under it was mud, water-soaked. The effect of the buttresses *E* was to transmit the vibrations of the engines to the walls of the building, and through these to their foundations in the mud, and through this mud to all buildings in the vicinity.

A prominent boiler maker calls for foundations as shown in Fig. 2. This consists in leveling off the ground and putting on 8 inches of concrete. Then comes about the same amount of brick. Spaces on the corners are then left out, for stones, and the brick is then continued up to the floor line. The corner stones are then laid in in cement. On these corner-stones rest the pillars that support the entire weight of boilers. Such a construction will have a tendency to break the corners out as shown at *F*, unless the ground underneath is very compact.

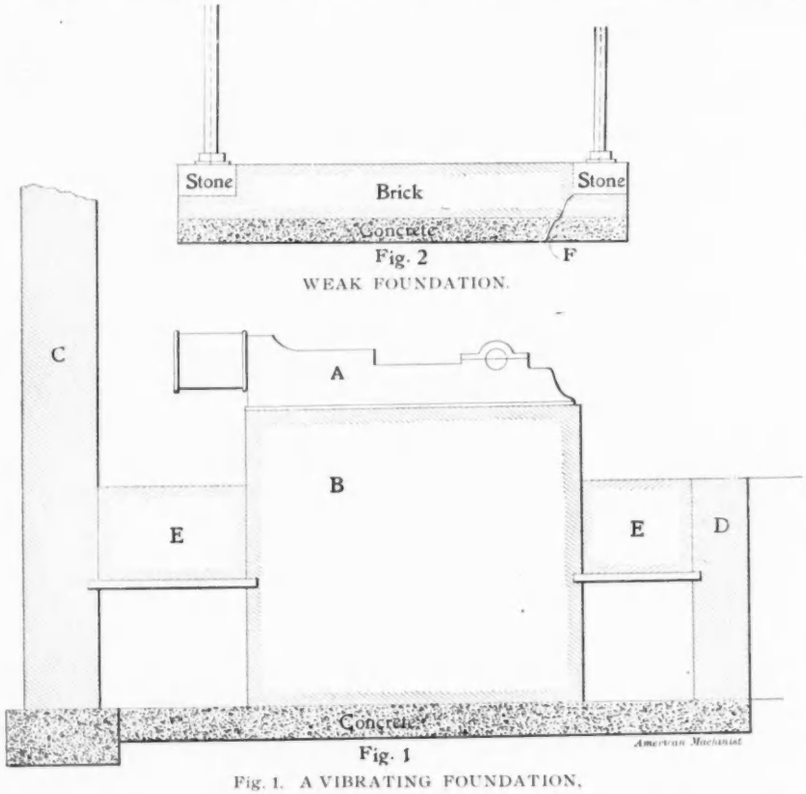


Fig. 2
WEAK FOUNDATION.

Fig. 1. A VIBRATING FOUNDATION.

Most of those who visited a recent exhibition noticed an engine standing on three points, and, as a general thing, noticed nothing farther. It is apparent that if you build three points into a solid foundation, then let these points extend up into the frame, then build the frame heavy enough so that it cannot jump high enough to jump off the points, the engine will stay in place. A heavy dynamo also helps to hold it. A looker-on who had had some experience with that class of engines playing see-saw when bolted down to an extra heavy foundation, looked around to the cylinder end to see how steady it was, and his eye followed the steam pipe until he observed that this was the only engine that had its steam pipe braced.

The writer wrote out some specifications for engine foundations that called for quarried stone, laid up dry and grouted. These specifications and plans passed through all stages of the contract, were accepted by the owners, and no objections were made until they were under way, when the engineer the owners called in objected to the plans for two reasons: First, he objected to stone, on general principles, and wanted brick. He appeared to have no reason for it except that everybody built of brick in that locality. I explained to him that a foundation was intended to hold an engine down as well as up, that weight was important, and that stone was heavier than brick, which he doubted until he had looked up his pocket books. It was further explained to him that a stone pier was not as elastic as a brick pier, and a stone foundation of the same size would be much more stable.

He then objected to the use of small stone that one man could handle, claiming that large stone with long bonds should be used. On this point it was explained to him that in the use of large stone a great many of them were dropped on the partially laid foundation, and also there was a great deal of prying with bars, all of which broke the partly set cement, and when the foundation was finished it would have lots of broken bonds. Rather than use large stones, use brick with less weight, more elasticity, but a more compact mass.

He then objected to grouting, claiming that one was not sure that all the interstices were filled, and that grout required longer time to set than where the stone was laid in cement. I told him that reminded me of an experience I once had putting up some foundations for a building where the architect had called for all of the joints to be filled with cement, but did not call for grout. The building of the walls had not been entirely satisfactory, and in one place it was necessary to have it water-tight, so I had this part laid up dry and grouted, being careful to watch the mixing of the grout. After pouring in several barrels and seeing no results, the foreman said they would have to have extra. Being asked what for, he replied that it took more cement that way. He was asked if he could get the wall more than full, but he insisted that that required a larger amount of cement than when stone was laid in it; but being pressed to answer the question if he could get it more than full, he replied no. He was told that his contract called for the wall to be full, so go ahead and fill up and there will be no extra, but probably a reduction on the walls already built. The engineer then told of a grouted wall that he had taken down that had a large place in it that had no cement of any kind. I could not understand then how such a thing could be, but have since seen specifications for grouted work to be made of Portland cement one part, and sand four parts. Such a mixture would not run down hill where there are no obstructions, much less horizontally in a stone wall.

W. E. CRANE.

Waterbury, Conn.

▲ ▲ ▲

The Elective System and Credit for Shop Experience in Engineering Schools.

Editor American Machinist:

My letter in your issue of April 16th has brought out the following statement from Prof. Wm. T. Magruder, which appears in your issue of September 17th: "To let the young student be his own director, and to let him decide what course he shall take to prepare himself for what he thinks is engineering, is to introduce disorder and to put a premium on ignorance, and to require a much larger teaching force. In a recent case, the young man selected steam engineering, machine design and the like, and left out the calculus, analytical mechanics and allied sub-

jects. His idea was that mechanical engineering was a trade which would teach him how to build and run engines."

This statement clearly proves two things: (1) That in the case cited there was gross incompetence on part of the faculty which evolved the so-called educational scheme under which such a worthless election could be made and accepted. (2) That Prof. Magruder has passed judgment on a plan which he has failed to investigate, and of which he clearly lacks accurate knowledge. The first is self-evident. The second is founded upon the mistaken notion that an elective system is necessarily a scheme which ought to be labeled "Graduating Made Easy." Nothing is farther from the truth, since a properly worked out elective system is the only one now in use, whereby every student is forced to attain a given degree of excellence in every branch credited to him, and to go through a course which is strictly logical and covers all requirements, yet is prevented from wasting his time on irrelevant subjects. To illustrate: Suppose that under the elective system such as I advocated, a man selected "steam engineering, machine design and the like" as the main object of his course. Referring to pages 63-73, and the sheet opposite page 48. Catalogue of the Michigan Mining School, and following out the list of subjects necessary for this work (in order to observe the sequence of studies, which is the keystone of the system), you will find that each and every one of the following subjects must be taken:

	Hours.
L 6—Machine Design	312
M 9—Mechanical Laboratory	495
M 8—Thermodynamics	52
M 7—Valve Gears	52
M 6—Testing Materials of Engineering	225
M 5—Mehanical Engineering	102
M 4—Mechanics of Materials	102
M 3—Mechanism	42
M 2—Shop Practice	495
M 1—Properties of Materials	60
C 1 and C 2—Analytic Mechanics	84
A 1 to A 5—Mathematics through Calculus	350
L 1—Mechanical Drawing	360
B 1—Physics	408
F 1—General Chemistry	252

Under no circumstances is anyone allowed to take up a single study until those which necessarily precede it are completed. No matter what a student elects, his list of studies will work out just as complete as the one above. I therefore fail to understand how anyone can claim this method "to put a premium on ignorance." In other words, an elective system thoroughly worked out and based on the natural sequence of studies is one thing, while an illogical scheme which permits the slothful to scramble for easy subjects is quite another thing, and a bad one at that. Nor does our system demand a large teaching force. Experience shows that a smaller force suffices, and that the work done is of higher grade.

It is perfectly true that "the engineering schools would be benefiting themselves and the profession by offering special inducements to men who had served their time in the shops, by mapping out a course and arranging a schedule by following which they could reach the coveted goal." Anyone who will throw aside his preconceived ideas of elective systems in general, and carefully investigate this one in particular, will find in it all the "special inducements" necessary for his case, if he is willing to work, but not otherwise.

Some recent school prospectuses are announcing that credit for shop work will now be allowed, and lead one to infer that this is a new departure. In reality such credit has been granted for years at some schools. For six years it has been allowed here whenever the student could give evidence of proficiency, and I recall no case where the results have been unsatisfactory to us.

EDGAR KIDWELL,
Michigan Mining School.
Houghton, Mich.

▲ ▲ ▲

Laying Out Bicycle Sprockets.

Editor American Machinist:

After reading the articles in your issue of August 27th, pertaining to formulas for computing the pitch diameter of sprocket wheels, I have come to the conclusion that someone's method is incorrect.

The first article, by Mr. A. L. Bowen, I think is rather crude and inaccurate. The second computation varies from the diameter, I find, only .0026. But I am at a loss to know how and where Mr. F. H. Bullard gets his constant .3187.

We will take the standard pitch, recognized as 1 inch by all the leading manufacturers of chains and bicycles throughout America, for a basis of computation. We, in our early studies in mathematics, were taught that the circumference of a circle of 1 inch in diameter is 3.1416. To obtain the circumference of any circle, we multiply 3.1416 by the diameter.

To obtain the diameter, we divide the circumference by 3.1416. Hence, when we start to compute the pitch diameter of a sprocket wheel, we divide the number of teeth by the constant 3.1416, because the number of teeth represents the circumference of the pitch diameter. Now, for example, we take an 8-tooth sprocket: $8 \div 3.1416 = 2.5464$ pitch diameter.

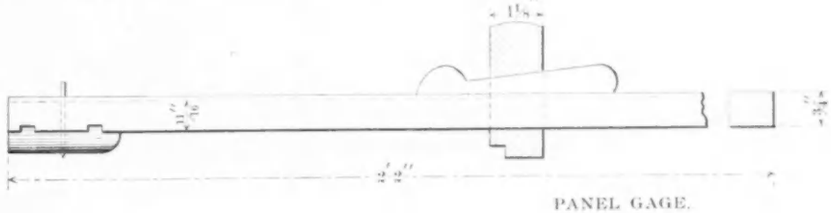
If we want a constant that we can multiply instead of divide, we divide 2.5464 pitch diameter by 8, number of teeth, and we have the constant .3183. This constant multiplied by any number of teeth will give you the correct pitch diameter.

To obtain the depth of cut, we subtract twice the distance from the center of pin, or rivet, to the bearing face of chain on sprocket, from the pitch diameter, and we have the diameter of sprocket at depth of cut, as, 2.5464 pitch diameter minus .325 (twice the distance on the Indianapolis chain) = 2.2214 diameter at bottom of cut. I believe there is no adopted standard for length of tooth above the pitch diameter. I have always found that if the tooth extends no higher than the length of the chain block above the center of rivet, that the chain will work all right. This will allow the chain to work smoothly and there will be no catch in its movements.

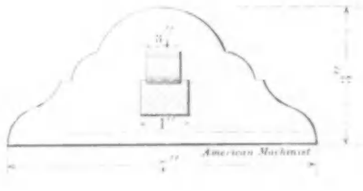
The lash should be about $\frac{1}{32}$ inch between the teeth to allow for inaccuracy; this we will all admit. This is no doubt either the unwillingness or inability of the chain manufacturers to make their product more accurate.

W. P. O'BRIEN.

[Our correspondent's method gives the pitch of the sprocket measured on the *arc* of the pitch circle. The pitch of the chain is measured on the *chord* of the arc; and if sprocket and chain are to mesh properly, the pitch of the sprocket should likewise be measured on the chord. Mr. Bullard's constant recognizes the correct principle, but it is not strictly correct, because the fraction should properly change with each diameter of sprocket—in other words, no such simple rule as Mr. Bullard's can be strictly correct, though it may be sufficiently so for practical purposes; $\frac{1}{32}$ inch backlash provides for same error in the rule.—Ed.]



PANEL GAGE.



Panel Gage.

Editor American Machinist:

Herewith I send sketch of panel gage, such as is used by pattern makers and joiners. It is similar to those in common use, with the exception of one feature, i. e., the top of the "staff" is recessed and the binding wedge made to a sliding fit. Consequently, when it is driven slightly it keeps the head and staff rigid. The proportions are a little heavier than those in general use; but I consider that a good fault. It is nearly fifteen years since I made it, and it has been in constant use up to the present, still retaining the advantages alluded to. The material is black walnut, with hickory wedge and block at ends.

WM. NEWTON.

Oneonta, N. Y.

▲ ▲ ▲

An Improved Key-Seating Machine.

The accompanying half-tone shows an improved key-seating or broaching machine, designed for factory use or wherever there is much key-seating to be done. At a single operation it will cut a key-seat in the hub of a pulley or gear, with a hole from ½ inch diameter upward, and key-seat up to ¾ inch in width and 8 inches long. The cutting is done by drawing once through the hole a cutter bar provided with a series of inserted teeth, each of which projects a trifle beyond the preceding, and each doing its share of the cutting required. Several of the cutting bars for different widths of key-seat are shown lying in front of the machine, and the construction and operation of the bar are shown in detail in Fig. 2. The bar is square in section and slides in a bush which fits the bore of the hole to be key-seated. The depth of the key-seat is determined by the gib *E*, which is inserted under the cutting bar. Parallel packing slips may be used under it if required. If a taper key-seat is to be cut, the taper gib E^1 is used. The teeth in the cutter are made of Stubs round steel, and in case one gives out it can be easily and cheaply renewed.

The cutting bar is drawn through the cut by means of the screw seen projecting at the left of the machine, the revolving nut being driven by the larger gear. An automatic trip is provided, which unlocks the nut (see Fig. 3) and allows a quick hand return of the bar. No clamping or fastening of the hub to be key-seated is required. When the operation begins, the cutting bar projects through the machine at the right, with the bush *F* upon it fitting the hole, and the hub is placed upon it and against the face plate. If a taper key-seat is to be cut, the face plate is tilted by means of the set screws behind it. It need not be said that the operation of the machine is rapid. It is also used for broaching square or other shaped holes, as in wrenches, handles, etc., by the use of suitable broaching bars. It is made by John T. Barr & Son, Kent avenue and South Sixth street, Brooklyn, N. Y.

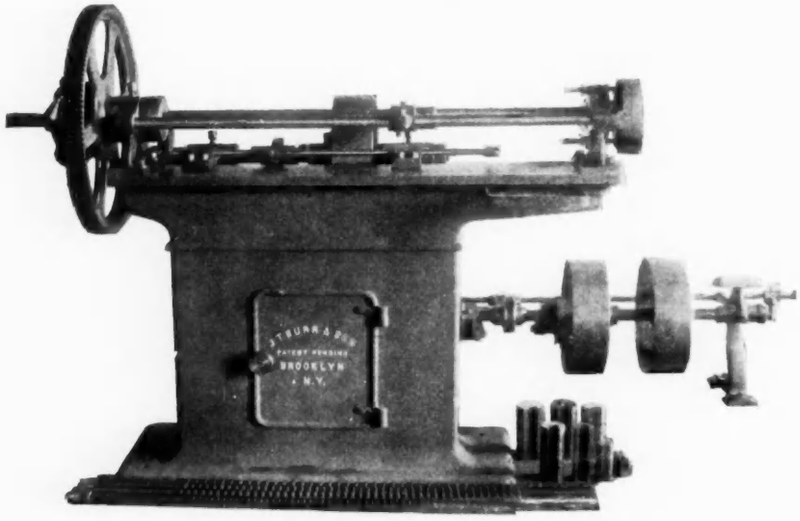


Fig. 1. AN IMPROVED KEY-SEATING MACHINE.

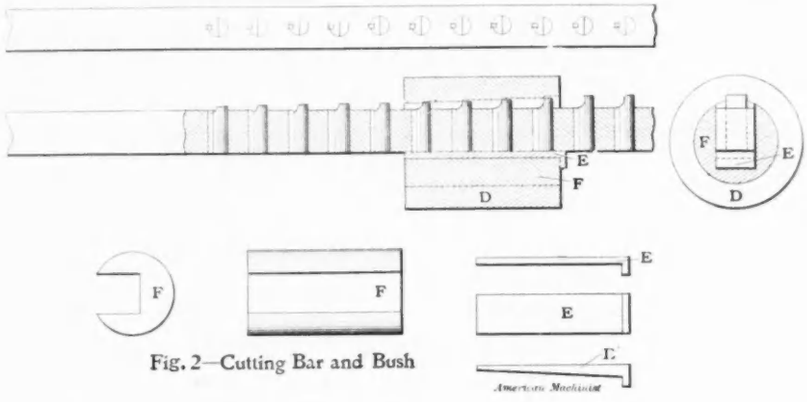


Fig. 2—Cutting Bar and Bush

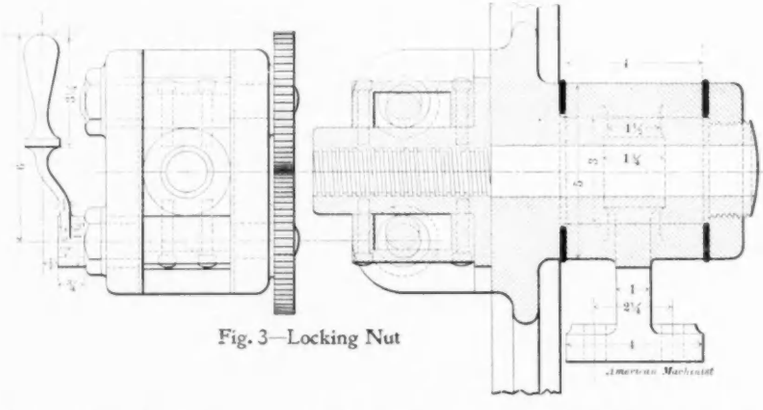


Fig. 3—Locking Nut

▲ ▲ ▲

A hearing before Governor Morton was held on the 7th inst., at which those arms manufacturers and inventors who are contesting the decision of the commision appointed to select an arm for New York State troops, presented their side of the matter. General Tracy, who represented the Winchester Arms Company, disclaimed any suspicion that there was corruption, but charged that Professor Thurston knew nothing of guns, that Mr. Bliss might have been influenced by his friendship for Mr. Savage, and that Mr. Shaw was prejudiced against the Winchester gun. General Tracy read from the records of the tests which were not placed in the report, to the Governor. These showed that the Winchester gun was superior at every range from 100 to 1,000 yards. It fired 119 per cent. faster than the Savage gun. These figures, he said, were not denied—yet the Savage gun was selected.

Transatlantic Engine Tests.

Editor American Machinist:

In your issue of September 3d, Mr. Harris Taber criticised the tests made in Europe of my engines. I, however, do not believe these tests are made in Europe much differently from the manner of making them in the United States. Everywhere the tests last ten hours; water is very carefully weighed, and diagrams are taken with the greatest care; indicator springs being accurately calibrated, warm, and compared with steam gage and mercurial column.

In a small country such as Belgium, where there are three active competitors, jockeying in tests should not be possible, as they are closely watching each other.

It is proven by all the tests made on these engines that even those of Corliss and Sulzer, built in Europe, could not equal ours, and the reason, it appears to me, is that these engines have difficulties in the shape of prejudicial spaces and surfaces.

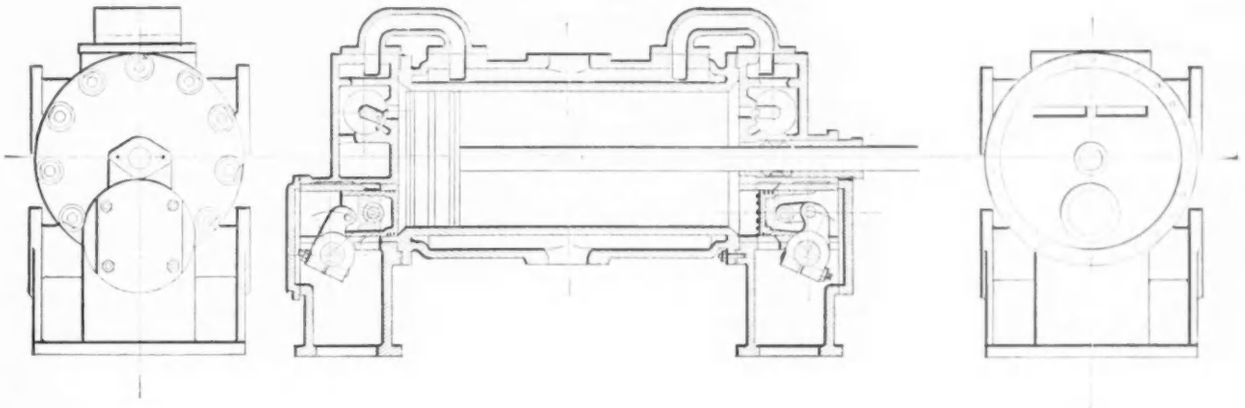
I hope Mr. Taber will soon have an opportunity of judging of the performance of this engine in his own country, but in the meantime I invite Mr. Taber to come to this country and himself supervise the test of an engine, and if the engine does not perform as claimed in the published tests, and do so to his satisfaction, I will pay him the expenses of the trip, amounting to not more than $600.

Allow me to present some particulars regarding my latest engine, which consumes yet 10 per cent. less than those, the results of tests of which were published in your issue of September 3d. The cylinder is made in three pieces bolted together; the case surrounds the cylinder perfectly, and steam enters in the upper portion, in order to be sure that it is entirely freed of water, and in order to make the case more efficient for the removal of condensed water which is deposited on the cylinder walls. The cylinder heads contain the valves which take their steam from the upper part of the case previously referred to. Steam enters the cylinder and meets a clearance space very much reduced—in fact, less than 1 per cent., and with surface for condensation yet more reduced, as it comes in contact only with the face of the piston and the face of the shutter or piston valve, which makes the discharge, and which is at that moment in direct line with the cylinder head, as can be seen at the left of the accompanying longitudinal section; the piston which performs the service of slide valve for the exhaust has a backward and forward motion, and thus uncovers the exhaust ports.

The piston I have been using in my engine for the past year proves to maintain its packing rings in excellent condition, the surfaces against which these rings work are made of hard cast iron, and the boring is made very true by means of grinding by an emery wheel used in a Landis universal grinding machine, and the piston is also ground in a similar manner, so that the rings only can wear away, and up to this time such wear is not perceptible. In fact, this wear must be very slight in all cases, since the speed of the piston is 10 or 15 times less than that of the engine piston, and it is also sure to be well lubricated, since the steam, which carries with it the cylinder lubricant, is obliged to pass through this valve.

H. Bollinckx.

Brussels, Belgium.



▲ ▲ ▲

Instruction in Steam Engineering.

The Steam Engineering Class of the Young Men's Institute, 222-224 Bowery, this city, opened its 1896-97 session on the evening of October 7, 1896, and will remain open until April 29, 1897. Wm. H. Weightman, M. E., is in charge as instructor. The object of the class is the instruction of all employed or expecting to be employed in the practical operation of engines, boilers and machinery, and who are desirous of gaining a knowledge of or improving themselves in the theoretical branches, rules and practice of steam engine, boiler and power transmission calculations. Those desiring to avail themselves of the opportunity should join the class at once. Sessions Wednesday and Friday evenings of each week.

▲ ▲ ▲

An Office Building Supplied With Compressed Air.

The Ingersoll-Sergeant Drill Company, who are, as is well known, extensive manufacturers of air compressors and of compressed air apparatus, have placed in the Havemeyer Building, where their offices are located, in this city, an air compressor, and the building is now so piped that a supply of compressed air may be obtained by any occupant of the building. A steam-actuated air compressor is placed in the basement with a large air receiver, a vertical pipe is run up through the pipe shaft, and horizontal pipes are led off at each floor, so that the air may be had wherever it is wanted. Air will be delivered up to 100 pounds pressure. In the Ingersoll-Sergeant offices, which are on the tenth floor, will be found air hoists and pneumatic tools and apparatus of various kinds, and parties who have compressed-air apparatus of any kind to exhibit will here find the means of doing so. The air will also be equally serviceable for operating or exhibiting steam machinery. The offices will also be equipped with various permanent compressed-air appliances for such purposes as ringing call bells, opening and shutting doors, operating letter presses, sweeping and dusting, cooling and ventilating, etc., and it is expected that these uses will develop throughout the building. The idea of the compressed-air equipment is said to be proving an attractive one to tenants, and we are informed that at least two additional ones have recently been drawn to the building by this feature.

▲ ▲ ▲

Moth-millers flying about the electric power house of the Pendleton, Ore., Light Company, entered the building through an open window one night, and being drawn by suction under a belt leading to the big dynamo, stopped the machinery and put out all the lights in town.

American Machinist.

Published every Thursday
by the
American Machinist Publishing Co.,
256 Broadway, New York.

Angus Sinclair, Pres't. John A. Hill, Treas.
C. A. Hansmann, Sec'y.
C. P. Day, Manager Adv. Dept.
Fred J. Miller, Editor.
Frank Richards, F. A. Halsey, Edward P. Buffet, } Associate Editors.
A. L. Donnell, Dept. of Illustration.

▲ ▲ ▲

Space in advertising pages only is for sale.
We invite correspondence on subjects pertaining to machinery.
Name and address must always be given, though not necessarily published.
Communications for or relating to the reading columns should be addressed to the Editor. All business communications should be addressed to the Company.
Subscribers can have their mailing address changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.

▲ ▲ ▲

SUBSCRIPTION PRICE:

$3.00 a year in advance, postage prepaid in the United States, Canada and Mexico.

$4.00 a year to other countries, postage prepaid.

Entered at Post Office, New York, as second-class mail matter.

For Sale by Newsdealers, Everywhere.

▲ ▲ ▲

Back Pressure in Single and in Multiple Expansion Engines.

Back pressure is a factor of greater importance in the compound or multi-cylinder engine of to-day than it can be in any single-cylinder engine. In a single-cylinder engine a pound is a pound, in back pressure as in steam pressure. In the compound engine a pound increase of pressure in the first cylinder will have a very different value from a pound decrease of the back pressure in the last cylinder, on account of the great difference of areas. In the compound, the triple or the quadruple expansion engine there is really but one back pressure, as in the single-cylinder engine. The back pressure in either cylinder except the last is practically of no importance, its adjustment by the cut-off in the succeeding cylinder affording a ready means of equitably apportioning the work to be done to the several cylinders, but not materially affecting the final result or the total work accomplished.

When we get to recognize the augmented influence of back pressure in the low-pressure cylinder of the multi-cylinder engine, there may still be some question as to the actual value to be assigned to it. We find ourselves, for instance, unable to quite accept the following statement of the matter which we find in a recent issue of "The Engineer," London: "Each pound of back pressure taken off (the low-pressure cylinder) represents very nearly all the advantage that can be secured by raising the pressure by an amount equivalent to the fall in back pressure multiplied by the ratio of expansion. Thus, for example, if the ratio of expansion be 20 to 1, and the indicated cylinder pressure 150 pounds, then, by reducing the back pressure 1 pound, we can secure the same advantage as would be obtained by raising the pressure 20 pounds; that is, to 170 pounds."

The two results compared above have actually nothing to do with each other, and are practically incomparable. A practical example will best serve to illustrate the case, and we find it most convenient to refer to our own columns. By the diagrams which we published from the engines of the "Paris" (then the "City of Paris"), the total I. H. P. was 19,174, while the I. H. P. of the two low-pressure cylinders was 7,249.2. The M. E. P. of both low-pressure cylinders was 14.4 pounds. If that was increased to 15.4 pounds by one pound reduction of the back pressure, the additional horse-power developed would be 503.4, or 2.6 per cent. of the total power. The initial pressure in the engines was about 150 pounds, and the ratio of expansion about 15. If the initial pressure was raised from 150 to 165, all other conditions remaining as before, the power developed would be increased 1,900 horse-power, or fully 10 per cent. This would be complicated by the fact that a greater weight of steam would be used, so that for a given weight of steam the gain would not be as great as here appears; but, as we said before, the two results do not seem to be properly comparable.

▲ ▲ ▲

Power Tests of Machine Tools.

The letter published elsewhere in this issue, entitled "Power Tests versus Time Tests," is, it seems to us, simply an up-to-date version of the old and famous story of the knights who quarreled about the color of a shield and found afterwards that both were right.

Mr. Swift is entirely correct in his contention that the time test in machine tool operations is so much more important than the power test that it is really hardly worth while to consider the cost of power. Convenience in handling the work and the cutting tools, and facility for applying tools to the work effectively, are so much more important than the amount of power required to drive belted tools that cost of power for this purpose need not be, and in fact seldom if ever is considered, except when we wish to know how large an engine and boiler to put in to drive a machine shop, or how large an electric motor we must attach to a given machine tool.

And it is just here that the value of our published tests of power consumed by machine tools comes in. These tests are not intended to interest the mechanic who is concerned in determining the economic efficiency of machine tools only, but the mechanic who must decide how much power must be provided to drive them, and is, for the time being at least, entirely unconcerned with questions of productive efficiency of the tools—he must arrange to drive them, regardless of their productive efficiency.

With the record of these tests before him, no one need make such serious mistakes as have sometimes been made in selecting engines, and especially motors for driving machine tools; and with a view to making the record as complete and comprehensive as possible, we shall add to it as opportunity offers. Heretofore there has been very little reliable data to guide us in such matters.

▲ ▲ ▲

By an agreement among the manufacturers composing the Cycle Board of Trade, the term of guarantee covering bicycles has been reduced from one year to six months. Inasmuch as the guarantees really cover nothing but defective parts, it is difficult to see any good reason for reducing the time, or, in fact, for limiting it at all. The fact is, however, that it is the general custom of riders to consider breakages as conclusive evidence of defects, and to insist upon replacement. These demands have been generally and weakly conceded by manufacturers and dealers, with the result that repair bills have become excessive. It seems to us that it would have been much better and fairer to have removed the time limit altogether, and agreed upon a stricter interpretation of the term "defective." As it now stands, careful and considerate riders, who know that bicycles have limits of strength, have to suffer for those who seem not to recognize any such limits, and simply "scorch" continuously, under all conditions, and "put up a stiff bluff" when anything breaks.

▲ ▲ ▲

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(178) D. C. L., Brockton, Mass., asks: 1. Can you give me any information as to who are the manufacturers of liquid air, and in what shape it is sold or supplied to the consumer? A.—We have no information of liquid air prepared for sale; if our readers can give us any information upon the subject we will thank them to do so. 2. Can you give a formula for the discharge of compressed air through a nozzle into the atmosphere; diameter of hole 1-16 inch, air pressure 100 pounds, gage. A.—We prefer not to offer a formula; from experiments within our knowledge we can say that the discharge in the above case would be between 6 and 7 cubic feet of free air per minute; that is, that it would be necessary to compress and deliver between 6 and 7 cubic feet of free air per minute to maintain the discharge and the full 100 pounds of pressure behind it.

(179) W. R., St. Louis, Mich., writes Seeing your answer to Question No. 169, September 24th, I would like to know the proper number of stays for the boiler referred to, with formula for figuring the same. A.—We do not know how the flues were arranged in the boiler, and the arrangement would determine to some extent the staying requirements. The heads of the boiler, it will be remembered, were $\frac{7}{16}$ thick, and with this thickness of head it is customary to use stays of 1-inch round iron. The sectional area of 1-inch round is .78 square inch. Then, as a stay must not be subjected to a strain exceeding 6,000 pounds per square inch of section, each stay must not have apportioned to it more than $6{,}000 \times .78 = 4{,}680$ pounds. If one-third of the boiler head (48 inches diameter) required staying, or $48^2 \times .7854 \times \frac{1}{3} = 603$ square inches, and if the maximum pressure for the boiler was 110 pounds, then the total pressure would be $603 \times 110 = 66{,}330$ pounds, and $66{,}330 \div 4{,}680 = 14.2$. Probably it would be best to use 16 stays, but, as we said, we do not know enough of the special boiler referred to, to give anything more than a very general answer.

(180) A. E. S., Montreal, Canada, asks: In placing figures on drawings, should the figures expressing the fractions be the same size as those expressing integral numbers, and what is the practice of the establishments on this point? Take the figures 12¾ inches as an example, and assume that the figures 12 are to be ⅛ inch high on the drawing, should the figures expressing the fraction ¾ inch be each ⅛ inch high, or smaller? A.—We do not think any rule can be laid down for this, and do not think there is a uniform practice. If we ourselves were placing figures upon a drawing, and the figures were large, somewhat larger than ⅛ inch, we should probably make the figures expressing the fractions smaller, because they would still be large enough to be legible, would look better, and take up less space if made somewhat smaller than the other figures. On the other hand, if the figures expressing the integral numbers were quite small, we would then make the fractional numbers nearly if not quite as large, and would place them vertically, each directly over the other, and without any line between them, instead of placing them diagonally as you have them and with a diagonal line between them. The size and arrangement of figures which makes them most legible and least liable to be misunderstood is the best one, and we do not think there is or should be a fixed rule of practice.

(181) T. J. W., New York, asks: Is it not centrifugal force which causes a belt to run in the middle of a coned pulley? A.—Centrifugal force has nothing to do with it. The pulley referred to in this case is, of course, a "crowned" faced pulley, or one which is coned or tapered each way from the middle line of the face. The action will perhaps be best understood by first taking a belt running over two straight or cylindrical pulleys on parallel shafts. The pulleys and the belt being perfect, we may assume that the belt will run continually along the same line on the two pulleys, with no tendency to move edgewise in either direction. If, however, one of the pulleys is changed for a taper-faced pulley, or one having a single coned surface, the belt will immediately begin to crowd toward the base of the cone or the larger side of the pulley. The pulley being larger in diameter at one side than at the other, is, of course, also larger in circumference there, and that edge of the belt is drawn along faster than the other edge. This draws the part of the belt that is approaching the pulley out of the straight line, and for this reason makes it lead more and more towards the big side of the pulley. If, now, we had another similar taper pulley placed by the side of the other, but reversed so that the big edges of the two pulleys come together, we can imagine the belt to go on crowding sidewise until more than half of the width of it has gone over from the first pulley to the second one, and then, of course, the tendency will be to make the belt lead the other way, and between the alternate action of the two cones the belt is induced to make a compromise between them and to stay in the middle.

▲ ▲ ▲

Business Specials.

Transient Advertisements 40 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear wheels, gear cutting. Grant; see page 9.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Engine Castings ⅛ to 2 H. P. Finished boilers and engines. Grant Sipp, Paterson, N. J.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Duplex and special gear cutters, counterbores, cutter and surface grinders, vertical millers, hand punches and shears. R. M. Clough, New Haven, Ct.

Patent Soliciting of High Class.—D. Walter Brown, Counsel in Patent Cases, 111 Broadway, New York. Send for "Brief History of Patent Legislation."

▲ ▲ ▲

State Organization of the National Association of Stationary Engineers in Massachusetts.

A convention made up of delegates from the Massachusetts local associations of the National Association of Stationary Engineers was held in Fall River, Friday and Saturday of last week, and a State Association of the National Association of Stationary Engineers was organized. A resolution granting permission for this action was passed at the last annual session of the national body, and Massachusetts is the first State to move in accordance with it. John W. Lane, Jr., president of the national body, was present and assisted in the work of organization.

By forming a State Association, the promoters expect to more closely cement the Massachusetts engineers than seems possible under the system of local associations to spread the work of education more thoroughly than has been done, and particularly to secure many needed changes in the law under which stationary engineers and firemen are licensed in Massachusetts.

The convention was successful in all things expected and undertaken. The delegates numbered 29, and every association in the State, except one, was heard from, favoring the plan of a State body, and that one was fearful only of the financial end of the plans. Mayor Greene welcomed the delegates and offered them the freedom of the city in most cordial terms. The first day's session consisted largely of preliminary work, such as the appointment of committees, etc. In the evening a semi-public meeting of engineers and mill superintendents was held, about 250 persons being present. Addresses were delivered by President Lane; Thomas Hawley, State Inspector of Engines and Boilers; George R. Babbitt, formerly of the Harris-Corliss Works, and other prominent members of the National Association of Stationary Engineers. A banquet was afterward tendered the delegates and guests by Troy Association, No. 6, of Fall River.

Saturday a constitution was adopted. Its provisions in no way conflict with the laws of the National Association. Annual meetings are to be held in June, and a per capita tax of 15 cents a year on all members was agreed upon. The following officers were elected for the coming year: Past President, Thomas J. Olys, Fall River; President, P. H. Hogan, Boston; Vice-President, F. D. Wheeler, Worcester; Secretary, Robert Place, Fall River; Treasurer, William H. Ramsdell, Lowell; Conductor, Thomas McQuilton, Lawrence; Doorkeeper, James R. McDonald, Athol.

▲ ▲ ▲

As we go to press, information comes that the American liner "Paris" has had the misfortune to break her starboard tube shaft, and is completing her eastward voyage by the use of her port engine and screw. Particulars are, of course, not at hand, but it is probably more than a mere coincidence that the breakage of this same shaft was given as the probable cause of the complete wreckage of the starboard engine in 1890, particulars of which we published at that time, and the inevitable conclusion would seem to be that either there is something wrong with the manner in which the shaft is supported or it is simply too small for the stress put upon it.

▲ ▲ ▲

Nine thousand tons of metal, mostly steel, are to be used in the construction of a 30-story office building, which is as much as would be required to lay 100 miles of track with 50-pound rails, so that if we are not building many miles of railroad, New York city alone is still making much business for rolling mills and other steel workers.

▲ ▲ ▲

An example of rare presence of mind was shown by a workman in Jersey City the other day, who, when he saw a fellow-workman's hand caught in the cogs of a machine which was drawing him in to meet death, promptly seized a crowbar and smashed one of the wheels of the machine, thus stopping it.

▲ ▲ ▲

It is announced to members that the fall meeting of the American Society of Mechanical Engineers will take place December 1st to 4th.

Literary Notes.

LOCOMOTIVE MECHANISM AND ENGINEERING. By H. C. Keagan, Jr. 409 5 x 7½ pages; 213 illustrations. John Wiley & Sons. Second Edition enlarged. Price not stated.

We are glad to note the appearance of the second edition of this book, especially as it has had added to it 98 pages on the electric locomotive, which besides descriptive matter, gives an excellent explanation of the principles of electric traction, together with diagrams of connections, controller, etc.

A PRIMER OF THE CALCULUS. By E. Sherman Gould. 4 x 6 inches, 91 pages, and 17 folded diagrams. Price, fifty cents. Van Nostrand's Science Series, No 112. D. Van Nostrand Co., 23 Murray street, New York.

In this little book the author aims at a demonstration of the rudiments of the calculus, with special reference to the utility of those portions of the subject which are taken up. The treatment is different from the orthodox method, inasmuch as the presentation of the theory is left largely till the later chapters—the author reasoning that the peculiar difficulties which many students experience in connection with the logic of the calculus become less formidable and are more easily overcome after a working knowledge has been acquired.

▲ ▲ ▲

Commercial Review.

NEW YORK, SATURDAY EVENING, OCT. 10TH.

MACHINISTS' SUPPLIES.

The multifarious lines of goods which are classed under the above heading have not yet begun to circulate freely in the market, but, according to appearances, their tendency is in the direction of greater activity than hitherto. The market is a mixed-up affair—more so than usually, if that were possible—but it seems safe to say that its undertone is better, upon the whole, than it was one or two months ago. Some concerns, it is true, are complaining of increased dullness, but others have no question of an improved trade, while many admit that, although business is still highly unsatisfactory, there is a little more demand than during the part of the season when depression was deepest.

A circumstance occasioning some comment this week is, that an establishment over forty years old, manufacturers of telegraph and railway supplies, electrical apparatus, etc., have just gone into the hands of receivers, which circumstance falls upon the market as an illustration of the vanity of human affairs and prompts the exclamation, "If these things are so, how can there be any improvement?"

EMERY WHEELS AND POWER TRANSMITTING MACHINERY.

Some brief reports as to what a few of houses dealing in these two lines of machinists' supplies are doing, may serve as examples of the general market. One emery wheel concern saw a trifling improvement in September over August, though little or none this month over September; another, while admitting that the tone of business may be slightly better than it has been, says that the reports from the main office are far from favorable. Another's business is said to be very dull.

In power-transmitting machinery, one of the principal houses reports that its trade has contracted rather than otherwise, although it is not idle, and is probably doing well, as compared with its competitors. A small concern dealing in wood pulleys, however, reports that its September business was three times as great as that of August, this year, and 40 per cent. ahead of September, 1895, although August, 1895, was better than August, 1896. Another wood pulley concern reports little change in trade.

THE FAVORABLE SIDE OF THE MATTER.

Patterson, Gottfried & Hunter, a large hardware and supply house, of this city, state that for about two weeks past the demand upon them for machinists' supplies has shown unquestionable improvement. With the South, for instance, they are conducting a good trade, notably in a specialty of theirs. Their retail trade in machinists' supplies seems to have about doubled. But such a report is exceptional.

A letter from a Western machine tool concern, though not altogether pertinent to the subject of supplies, may here be given. The Davis & Egan Machine Tool Company, of Cincinnati, write, under date October 5th: "We are pleased to report a general improvement in trade during the past ten days. We have received quite a number of good orders from various parts of the United States, and our foreign business continues good. Inquiries are plentiful, and we anticipate a brisk trade immediately after the election."

A certain manufacturer of engines high in speed and grade, writes us: "Our business has been struck with a cyclone. . . . We have more orders for engines than we ever had at once before, which is more than we could furnish in three months, if we did not have half of them in stock."

THE OUTLOOK.

For so long a time have shops, mills and factories felt the necessity of economizing, and have undoubtedly kept themselves upon a starvation diet of such new machinery or supplies as could be limited in quantity without blocking work, that a seller may picture to himself glorious replenishment of stocks when the restoration of confidence is at last a reality. It has been remarked, by the way, that when a shop shuts down, the files that have been in use are apt to get so knocked around that a new supply is necessary upon reopening.

EXPORT TRADE NOTES.

Miller Bros. & Co., of Pittsburg, have contracted to erect a large steel plant in Manipol, Southeastern Russia.

A consular report from Switzerland states that American pig iron, steel and tools are wanted there. A leading concern in Zurich says that they want 40,000 tons of pig iron for foundry purposes, 55,000 tons of blooms, billets, wire rods, bars and sheets; 3,200 tons of pipes and tubes, and 2,000 tons of hardware goods, chains, bolts, nuts, screws, etc.

A gentleman who holds agencies in England for several well-known American tool manufacturers is now in this city, and says that one of his chief difficulties in business of late has been that of getting goods soon enough to satisfy his customers. At home he has been the recipient of numerous calls from Americans; as many as nine of these visitations being the record at the office in Birmingham for one day; which goes to show that our manufacturers have taken the export subject well in hand.

The Monthly Summary of Finance and Commerce for August, issued by the United States Treasury Department, shows the following: Exports of machinery from this country for the month of August, 1896, amounted to $2,208,165, against $1,682,778 for August, 1895. The report published for July, 1896, showed $2,176,162. For the eight months ending August the exports of machinery have been $15,740,371, against $10,792,812 for the first eight months of last year. (The official figures include steam engines, boilers, locomotives, etc., and in the comparison it is to be noted that since July 1, 1896, they have included printing presses and typewriters, which have amounted to $377,741 for the eight months of this year.)

The exports of cycles and parts of cycles for the month of August amounted to $350,895, and for the eight months of the year $2,449,260. Of the total, $915,257 worth went to the United Kingdom, and British North America was the second best purchaser, with $492,118. Following this came, respectively, Germany, British Australasia and France. Much more than half of the total went to Great Britain or British possessions.

Fifty-seven locomotives were exported during August and 252 during the eight months, as compared with nine and 121 for the corresponding periods of 1895.

The returns made public through the New York Custom House during the week ending October 10th, show exports of machinery from the Port of New York, which we sum up at $257,942. These reports are often made two or three weeks later than the date of clearing of the vessels, but are published in advance of those given in the Government statistics.

IRON AND OTHER METALS.

According to reports in this city, the pig iron market is now in a state of partial reaction from its comparative briskness of some ten days ago. A favorable sign,

(Continued on page 37.)

Help Wanted.

Situation and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The Cash and Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our subscription list, this paper will give two free insertions under this heading to those in want of positions. The advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

Help Wanted—Good pay for leisure hours. Address Geo. W. Lord, Philadelphia, Pa.

Mechanical draftsman desires position; good references. Box 78, AMERICAN MACHINIST.

Experienced mechanical draftsman wants position; best references. Box 96, AMER. MACHINIST.

Expert draftsman, experienced machine designer, open for engagement. Box 73, AM. MACH.

Wanted—Thoroughly pract'l mechanical draftsman; give age, reference and wages expected. Address Box 87, care of the AMERICAN MACHINIST.

Experienced man on design, construction, erection and repairs of coal mine machinery and locomotives wants work. Address box 93, AM. MACH.

An experienced designer wishes to change; well up on Corliss and automatic engs., modern shop & office systems; moderate salary. Box 86, AM. MACH.

An erecting engineer and floor man wants position; would take a position as stationary engineer; best of references. Box 95, AMERICAN MACHINIST.

Wanted—Position by a thoroughly first-class pattern maker, 15 years' experience; can furnish best of references; age 37; capable of taking charge. Box 89, AMERICAN MACHINIST.

Competent mechanical engineer, A1 constructor, owner of valuable inventions, would like position with some reliable concern. Address. Editor Kansas City Presse, Kansas City, Mo.

Wanted—Experienced foreman for assembling & finishing dept., making cyclometers, combination locks, etc.; steady employment; first-class refs. required. Address U. S. Mfg. Co., Fond du Lac, Wis.

Wanted—Position by a first-class die and tool maker; thorough machinist; 18 years' experience and for the last 10 years in charge of die and tool room. Address Box 98, care of AMERICAN MACHINIST.

Wanted—A good practical machinist to go in partnership with a moulder having an established foundry and machine shop business in a good mining country. Address all communications to box 92, AMERICAN MACHINIST.

Position wanted as foreman on screw, milling & drilling machines, automatic or hand; have had charge of sewing machine and bicycle works for 16 yrs.; am expert screw machine & screw tool hand; know how to handle help. Box 85, AM. MACH.

A young technical graduate, understanding practically the details of machine construction, would like position with a reliable house, either as a draftsman or otherwise where mechanical genius is required. A. B. & C., P. O. box 2,890, N. Y. city.

Wanted—A superintendent for small shop manufacturing on interchangeable system. Should be instrument or tool maker. Knowledge of electricity and business experience desirable. State age, experience and salary. P. O. box 462, Philadelphia.

Wanted—A tool maker of wide experience to take charge of tool room in a small shop; must be a first-class workman of good character and well recommended. Steady work with fair pay to the right man. Box 94, AMERICAN MACHINIST.

Wanted—A man between 30 and 45 years of age who has had a thorough practical shop experience in building light manufacturing machinery, automatic or otherwise; also small special fixtures, edge tools, punches, dies, etc.; one who has had experience in handling skilled workmen to best advantage as to quantity and quality. A permanent position is open to such a man. None except those thoroughly competent need apply. Applications treated confidentially if so desired. Address, with age, reference, salary, experience, etc., Box 97, AMERICAN MACHINIST.

▲ ▲ ▲

Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d h'd lathes & planers. S. M. York, Clev'd, O.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Best and cheapest Bolt Header, made by Bausch & Harris Machine Tool Co.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Boye, Cincinnati, O.

We make a specialty of Shartle's patent safety set collars. Prices low and samples free. Middletown Machine Co., Middletown, Ohio.

We offer an exceedingly fine lot of first-class second-hand machinery, lathes, planers, shapers, drills, millers, screw machines, etc. Call, or get list 17 B. The Garvin Mach. Co., 440 Canal st., N.Y.

Wanted—A full lot of second-hand improved machine tools issuing from cycle manufacturer wishing to sell his machinery. Address prices and complete description of every machine to Mr. Pinet, 66 Cours de Vincennes, Paris, France.

Wanted—An Idea. Who can think of some simple thing to patent? Protect your ideas; they may bring you wealth. Write John Wedderburn & Co., Patent Attorneys, Washington, D. C., for their $1,800 prize offered to inventors.

Just Published. Two Reliable Books.

"SHOP KINKS,"

By ROBERT GRIMSHAW. Showing special Ways of Doing Work Better, more Cheaply, or more Rapidly than Usual.

400 Pages, 225 Illustrations, $2.50.

"THE MODERN MACHINIST," By JOHN T. USHER, Machinist.

320 Pages, 257 Illustrations, $2.50.

☞ *Illustrated circulars of both sent free.*

NEARLY READY.

"GAS, GASOLINE AND OIL ENGINES,"

By GARDINER D. HISCOX, M. E.

400 Pages. 200 Illustrations. Price, $2.50.

This book treats comprehensively, and almost entirely of American makes of Gas, Gasoline and Oil Engines, with instructions for the care and management of the same.

Our Catalogues of Books for Machinists, Engineers, Electricians, etc., also sent free.

NORMAN W. HENLEY & CO., Publishers,
15 Beekman Street, NEW YORK.

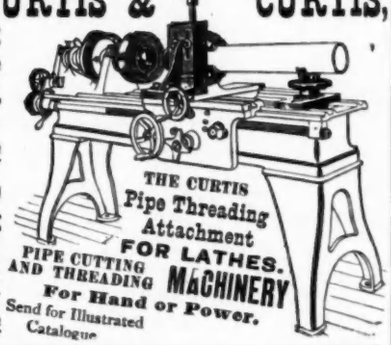
EMERY AND CORUNDUM WHEELS

For all grinding purposes, wet or dry, with or without WIRE-WEB. *FREE CUTTING—NON-GLAZING—LONG WEARING.* Send for interesting new Circular "E."

VITRIFIED WHEEL CO., Westfield, Mass.

CURTIS & CURTIS,

66 Garden St., Bridgeport, Ct.



4 Lathes, 10 to 14 in. swing,	$95 to $120
1 Grinding Lathe, 17 in. swing, 6 ft. bed,	100
1 Planer, 17 in. x 17 in. x 4 ft. bed,	150
1 Planer, Rig Milling Machine,	75

FOGARTY CO.,
84 Sedgwick Street, BROOKLYN, N. Y.

TOOLS

Now, there's FRED FRASSE, he's got a new "hard times" tool book. The prices are simply ridiculous. He's doing a large business even in these hard times. Rock bottom prices. They tell the story.

TOOLS

43 Cents.

Postage Paid.

TOOLS

STEP ON THIS CHANCE WITH BOTH FEET

and get tool book free.

TOOLS

17 Warren Street, NEW YORK. Near Broadway.

1000 cuts.

TOOLS

(Continued from page 36.)

however, is the existing reluctance of furnaces to place contracts for next year's delivery at present prices, though there is no difficulty in effecting such purchases at 25 cents advance.

It is rumored that some important changes may be made in the official personnel of certain steel companies.

Tameness is still a leading feature of the metals. Pig tin has descended to still lower quotations, but early in the week a fair amount went to out-of-town trade and to consumers. The tone of copper is tolerably good.

Quotations.

NEW YORK, Monday, October 12th.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$11 75 @ $13 00
No. 2 foundry, Northern	11 25 @ 12 00
No. 2 plain, Northern	10 50 @ 11 00
Gray Forge	10 50 @ 10 75
No. 1 foundry, Southern	12 00 @ 12 25
No. 2 foundry, Southern	11 00 @ 11 25
No. 3 foundry, Southern	10 50 @ 10 75
No. 1 soft, Southern	11 00 @ 11 25
No. 2 soft, Southern	10 75 @ 11 00
Foundry forge, or No. 4 Southern	10 25 @ 10 50

Bar Iron—Base—Mill price, in Carloads, on dock; common, 1.12 @ 1.15c.; refined, 1.20 @ 1.50c. Store prices: common, 1.40 @ 1.50c.; refined, 1.50 @ 1.80c.

Tool Steel—Ordinary sizes, standard quality, 5½ @ 7c.; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—From store, 1.65 @ 1.75c. Special brands upward.

Cold Rolled Steel Shafting—Base size in carloads, about 2½c.; 2¾c. for smaller quantities from store.

Copper—Carload lots, Lake Superior ingot, 10¾ @ 10⅞c.; electrolytic, 10½ @ 10⅝c.; casting copper, 10¼ @ 10½c.

Pig Tin—For 5 and 10-ton lots, 12.70@12.80c., f. o. b.

Pig Lead—In carload lots, 2.75 @ 2.80c., f. o. b.

Spelter—In carload lots. New York delivery, 3.70 @ 3.75c., f. o. b., for various brands.

Antimony—Cookson's, 7.25c.; Hallett's, 6.50c.

Lard Oil—Prime city, present make, commercial quality, in carload lots, 40 @ 42c.

▲ ▲ ▲

Manufactures.

The Water-Gas Co., New Castle, Del., will install new machinery.

Mann Edge Tool Co., Lewistown, Pa., intend to install new machinery.

West End Water Co., Lancaster, Pa., are about to place new machinery.

The Franklin Asbestos Mfg. Co. Franklin Pa., are doubling the capacity of their works.

The Punxatawney Steel Co. will build a new open hearth steel plant at Punxatawney, Pa.

The city of Canton, Pa., will erect an electric light plant, and install new machinery.

A. A. Stevens & Co., Tyrone, Pa., will erect a shoe factory, and install new machinery.

The Model Roller Mills, Cleveland, Tenn., will install boilers, engine and mill machinery.

The Electric Light Co., Dover, N. J., will install new machinery of the latest improved type.

Myers & Funkhouse, Mt. Crawford, Va., will erect an electric plant, and install new machinery.

The city of Franklin, La., will build a large water works, and put in improved machinery.

The Rochester, Pa., Electric Light Co. have begun operations on a large addition to their plant.

Boyd Bros., Riceville, Tenn., will build a wagon factory, and install new and improved machinery.

The Southern Electric Co., Baltimore, Md., will install new and improved machinery, expending $70,000.

A new farming implement works is to be built at Kansas City, Mo., by the Eagle Mfg. Co., capital $100,000.

The Collins-Hale Mfg. Co., Scranton, Pa., with a

capital of $40,000, will place a lot of new machinery.

The Chambersburg Electric Light Co., Chambersburg, Pa., will increase their plant, and install new machinery.

The Jumbo Mfg. Co , Sisterville, W.Va., will build a plant for manufacturing tools, and install new machinery.

The city of Grand Haven, Mich., has just voted to bond for $10,000 to build a municipal electric light plant.

The Londonderry Iron Co., Londonderry, N. S., contemplate extensive improvements to their plant in the near future.

The Peerless Pipe Covering Co., Norristown, Pa., will rebuild their plant in the near future, and place new machinery.

Gladfelter & Nace, Middlesex, Cumberland Co., Pa., will increase their steam mills, and put in a line of new machinery.

A large pipe mill will be built at Los Angeles, Cal., by Pacific Coast Pipe Co., of which R. J. Northman is secretary.

Holland & Weisner, Salem, N. C., will erect a plant for manufacturing chairs, and will install latest improved machinery.

J. Heard & Co., carriage woodenware manufacturers, St. Thomas, Ont., Canada, have decided to increase their factory and plant.

The London, Ont., Canada, Street Railway Co., will increase their power plant, and it is reported will sell power for motor purposes along their route.

Buhl Steel Co., Sharon, Pa., are intending to install new pumps, condensers, heaters, rolling mill machinery. Mr. S. W. Huber is the consulting engineer.

A. M. Jolly, A. S. Moore, John Warren and others, of Beaver Falls, Pa., have organized the People's Water Company and will install a system at Rochester, Pa.

Eaton Rapids, Mich., will erect a $39,000 electric light and power plant for city lighting and power. Engines, pumps, dynamos and other electrical machinery will be installed.

The Hall mines, Nelson, B. C., will install more machinery and add to the capacity of the smelter. A crusher, 12-drill compressor and two 80-horse power boilers will be put in at the mines.

The Jenkins Coal Mining Co., Grand Ledge, Mich., will open new mines in their fields, excavating, drilling, hoisting engines and machinery, cables, pumps, electric light plant, etc., will be installed.

The Sault Ste. Marie Lumber Co., Sault Ste. Marie, Mich., will erect a large lumber manufacting plant costing $35,000. Band mills, edgers, engines, pumps, and all modern improvements usually found in a first-class lumber mill will be installed.

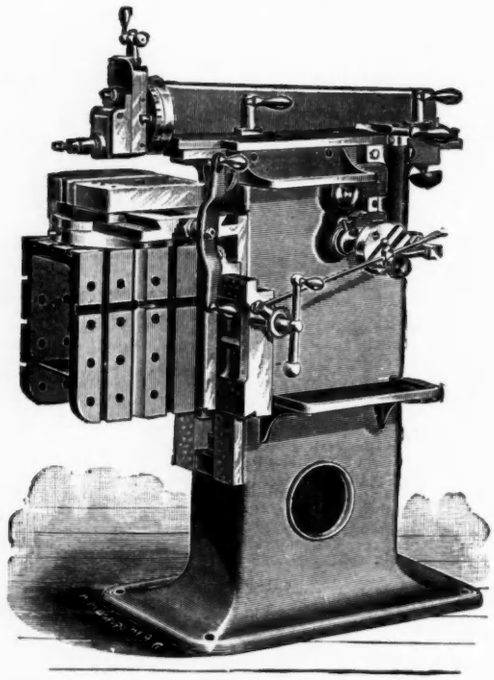
The Lagonda Cycle Co. has been incorporated at Springfield, O. Among the incorporators are C. E. Petrie, J. M. Goode, I. W. Frey and C. H. Pierce. $200,000 has been subscribed, and it is understood that the "Knife and Bar" shop will be used for the manufacture of the cycles.

Mr. J. H. Dunbar, of Youngstown, O., informs us that his business of making packing rings for engines has grown to such magnitude as to warrant considerable enlargement, and that increased facilities will be required for the manufacture of these rings on an extensive scale.

A company, to be known as the Lucknow Central Furniture Co., to manufacture, wholesale and retail, a general line of furniture at Lucknow, Ont., Canada. Capital $20,000. Applicants of incorporation: D. B. Forster, G. W. Berry, Wm. Henry Johnston, John G. Murdoch and Alex. Morton.

Lake Superior Power Co., Sault Ste. Marie, Mich., will erect a large plant for the manufacture of calcium carbide. $40,000 to be expended on limestone and coke crushers, dynamos, improved

(Continued on page 39.)



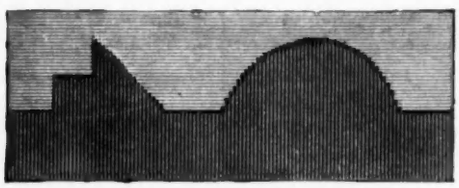
Improved 15" Hendey Shaper.

Latest Improvements.
Useful : Attachments.
Strong and Powerful.

For Die Work, Tool Room or General Shop Work.

▲ ▲ ▲ ▲ ▲

The stroke can be adjusted for curves with machine in motion. The stroke can be adjusted for angles with machine in motion. The stroke can be adjusted for irregular work with machine in motion. It has adjustable table for planing taper work, table can be removed for fastening work to apron. Has a strong graduated swivel vise. Quick work, rapid changes, modern ideas.



This cut shows how stroke can be adjusted with machine in motion by micrometer, adjustment fine and delicate. Send for circular.

The Hendey Machine Co.

Torrington, Conn.

European Agents, { Chas. Churchill & Co., London and Birmingham. Schuchardt & Schutte, Berlin and Vienna. Eugen Soller, Basel, Switzerland.

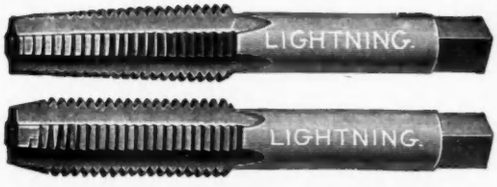
The Pratt & Whitney Co. HARTFORD, CONN., U.S.A.

...MAKERS OF...

Fine Machine Tools.

Complete Plants furnished for Bicycle, Typewriter, Gun and Sewing Machine Makers. Gauges and Small Tools for all Machine Work. Drop Hammers and Trimming Presses. Forging and Trimming Dies for all classes of work.

England—Buck & Hickman, 280 Whitechapel rd., London, E.; Chas. Churchill & Co., Ltd., London and Birmingham. *France*—F. G. Kreutzberger; Fenwick Freres & Co., 21 Rue Martel, Paris.
Chicago—42 and 44 S. Clinton st. *Boston*—281 Franklin st. *New York*—123 Liberty st.



Finest Machine Relieved Taps.

Also, Dies, Screw Plates, Reamers, Etc.

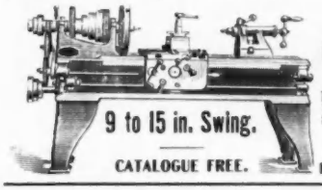
SEND FOR CATALOGUE.

WILEY & RUSSELL MFG. CO.,
GREENFIELD, MASS., U. S. A.

How To Run Electric, Simple and Compound Locomotives.

JOHN WILEY & SONS,
53 East 10th Street, NEW YORK CITY.

SECOND EDITION
REAGAN'S LOCOMOTIVES
12mo, Cloth, $2.00.
RIGHT UP TO DATE.



CATALOGUE FREE.

4 POINTS!!!! Design! Workmanship! Material! Finish!

All these are comprised in the make-up of our lathes and are the four necessary points in the construction of a good tool. Add to these a FIFTH and a very important one, the price, which we make very low to prompt cash buyers, and you have the story. Our Catalogue will tell you all about our Lathes, Planers, Shapers, etc.

SEBASTIAN LATHE COMPANY,
117 and 119 Culvert Street, CINCINNATI, OHIO, U.S.A.

DYER & DRISCOLL,
PATENT SOLICITORS, 36 WALL ST., N.Y.

Have done all my patent soliciting work, both for this and foreign countries, continously for the past fourteen years.
Thomas A. Edison

STAR LATHES
★★★
Foot Power Screw Cutting, Automatic Cross Feed, 9 and 12" Swing.
Send for Catalog B.
Seneca Falls Mfg. Co.
697 Water St., Seneca Falls, N.Y.

'96 THE NEW '96 JENKINS '96

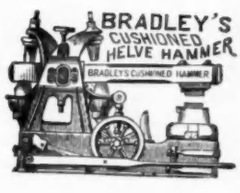
IS the Perfection of Joint Packing. Instantaneous, **Does Not Squeeze Out** and not necessary to follow up joint. We guarantee it to last for years on any and all pressures of steam or any kind of joint where packing is required. Does not rot, burn or blow out, therefore the best for all purposes. Call for and insist on having '96 JENKINS '96, stamped like cut. . . . . .

JENKINS BROS., New York, Boston, Phila., Chicago.

Walker Universal Tool and Cutter Grinder.

SEND FOR COMPLETE CATALOGUE.

NORTON EMERY WHEEL CO.
WORCESTER, MASS.



BRADLEY HAMMERS

THE BEST POWER HAMMERS ON EARTH.
22 sizes in Helve, Upright and Strap Styles.

Send for Printed Matter.

The Bradley Company
Syracuse, N Y.

(*Continued from page 38*)

water turbines, cables, pumps and other machinery necessary in the manufacturing of the product.

Mr. O. S. Kelly, Springfield, O., it is reported, has stated that a deal with an English syndicate will in all probability be completed, which will mean the commencement of the manufacture of the "New Champion," the local name for the shops of the Champion Machine Co., which assigned some time ago.

Negotiations are now in progress looking toward the location of a shovel factory at Scottdale, Pa. J. M. Roland, of Philadelphia, will superintend the plant. About $26,000 have been subscribed. A capital stock of $35,000 is asked for, which would be ample to construct buildings, provide machinery, etc.

A company, to be called the Ottawa Printing Co., Ltd., have applied for a charter of incorporation to do the business of book and job printing, binding, engraving, lithographing, etc. Chief place of business, Ottawa, Ont. Capital $10,000. C. S. O. Boudreault, Jno. Geo. Kilt, Hy. C. Monk, C. H. Carriere, A. W. E. Hellyer and M. K. Nolan are the applicants.

The Empress Mining Co., Ltd., to operate in the Province of Ontario in a general mining business, are seeking incorporation as miners and smelters, with headquarters at Fort William, Canada. Capital $1,000,000. Geo. A. Graham, John T. Horn, of Fort William; W. Ross, Rat Portage; Geo. Clatel, Port Arthur, and Alex. R. Bartlett, Windsor, Ont., are the applicants.

▲ ▲ ▲

New Catalogs.

There are three sizes of Standard Catalogs, first authorized by the Master Car Builders' Association, 9" x 12", 6" x 9" and 3½" x 6". We recommend the 6" x 9" size for machinery catalogs. When they must be larger or smaller, one of the other standard sizes should be adopted if possible.

The Jeffry Manufacturing Co., of Columbus, O., send us a copy of the 1896 edition of their catalog of link belting in various forms and applications, 5 x 7½ inches.

The Springfield Machine Tool Co., Springfield, O., send us a small pamphlet describing and illustrating their lathes, presses, etc. The pamphlet is 3¼ x 5¾ inches.

We have received from John T. Burr & Son, Brooklyn, N. Y., a catalog devoted to the illustration of the "Burr Portable Key Seater." The catalog is 5¼ x 7 inches.

The Pope Tube Co., of Hartford, Conn., send us a catalog of their products in this line of manufacture. The catalog contains some very useful tables of weights, internal diameters, etc., and is 7¼ x 9¼ inches.

The Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., have sent us a catalog illustrating presses, shears, buffing lathes, drop hammers and numerous other tools manufactured by them. It is 5¼ x 6¾ inches.

Rudolphi & Krummel Machine Works, Chicago, Ill., have issued a catalog devoted to the description and illustration of presses, dies, wire working machines and machinery used in the manufacture of bicycles. The catalog is 8½ x 11 inches.

J. A. Fay & Co., Cincinnati, O., send us a pamphlet entitled "Wood Workers," which illustrates and describes various kinds of wood-working machinery, such as planers, mortisers, sand-papering machines, etc., manufactured by them. The pamphlet is 8 x 10¾ inches, and will be sent on application.

Morse, Williams & Co., Philadelphia, Pa., send us a catalog which illustrates and describes elevators driven by steam, electricity, hydraulic power, also general hoisting machinery. The catalog contains pen and ink sketches of these elevators, and is 9¼ x 12¾ inches.

A. A. Griffing Iron Co., Jersey City, N. J., send us a large catalog of the "Bundy" sectional tubular heater manufactured by them, and which is made

in two styles: one for steam and the other for water. The catalog contains views of both styles, and is 13¾ x 13¾ inches.

P. Blaisdell & Co., Worcester, Mass., send us their 1896 catalog containing illustrations and descriptions of machinists' tools manufactured by them. Among these are lathes, drills, planers, etc. Various styles of the aforementioned tools are shown, and the catalog is 6 x 9¾ inches.

We have received from J. T. Slocomb & Co., 235 Eddy st., Providence, R. I., a catalog and price list of machinists' tools made by them. The catalog contains illustrations and descriptions of calipers, depth gauges, micrometer gauges and other tools used by machinists, and is standard size, 6 x 9 inches.

The U. Baird Machinery Co., Pittsburgh, Pa., have issued their catalog B of iron and wood working machinery which can be supplied by them. The catalog contains illustrations and descriptions of a large variety of machine tools, such as lathes, drills, planers, etc , has 656 pages, and is standard size, 9 x 12 inches.

The Westinghouse Engine Co., Pittsburgh, Pa., send us a catalog illustrating and describing various kinds of engines used for electric light and power purposes and manufactured by them. Half tone engravings are shown of several plants which are supplied with these engines. The catalog is standard size, 6 x 9 inches.

Fairbanks, Morse & Co., Beloit, Wis., have issued a new catalog which contains illustrations and descriptions of their gas and gasoline engines, various styles and sizes of these engines being shown. The catalog also contains testimonials from those who have had experience in the use of these engines. It is 6¾ x 9 inches.

We have received from Geo. H. Olney, 163 Herkimer st., Brooklyn, N. Y., a catalog containing detailed list of parts for model locomotives manufactured by him. The list is very complete, and the catalog is 6 x 9¼ inches It will especially interest amateur mechanics and others who may wish to build small locomotives.

The Warder, Bushnell & Glessner Co., of Springfield, O., send us a fine catalog illustrating and describing their line of "Champion" harvesting machinery, mowers and self-binding reapers. The catalog is uncommonly well illustrated and gives a good deal of detailed information about the most modern American harvesting machinery. It is 5 x 8 inches.

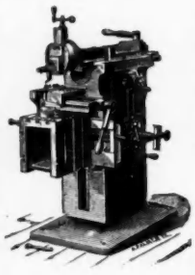
The Boston Gear Works, Boston, Mass., send us a catalog illustrating and describing various styles of gears, joint couplings, racks, bicycle chains, etc., made by them. The catalog also contains some very useful information for those interested in such machinery, such as suggestions on gears, tables of diametral and circular pitches, etc. It is 5¼ x 8 inches.

Betts Machine Co., Wilmington, Del., send us three catalogs illustrating and describing boring and drilling machines, boring and turning mills and planing machines, respectively, manufactured by them. Each of these catalogs contains excellent half tone pictures of the machines, and also the names of some of the users of them. The catalogs are 6¾ x 9¾ inches.

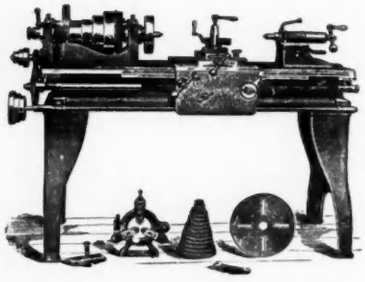
Houston, Stanwood & Gamble, Cincinnati, O., send us a catalog devoted to the illustration of horizontal engines, boilers, etc., made by them. Accompanying the catalog is a book of ready reference for engineers and steam users, which contains considerable useful information. The catalog and reference book will be sent on application. The former measures 7¾ x 10¾ inches.

We have received from the Snow Steam Pump Works, Buffalo, N. Y., a well gotten up catalog devoted to the illustration and description of steam pumps and hydraulic machinery made by them. End and front elevations and sectional views of the various styles of pumps are given, also much information which will be of service to those who have to do with this class of work. The catalog contains 94 pages, is well bound and is 5¾ x 8½ inches.

MODERN MACHINE TOOLS



Lathes, Screw Machines,
Planers, Turret Lathes,
Millers, Drills,
Shapers, Radials,
etc., etc., etc.



PRENTISS TOOL AND SUPPLY CO.

Metal Working Machinery.

EXPORT TRADE A SPECIALTY.

NEW YORK STORE: 115 Liberty St.

Cable Address "Prenco."

CHICAGO STORE: 62-64 S. Canal St.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.

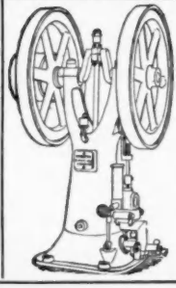
J. M. ALLEN, President.
WM. B. FRANKLIN, Vice-President.
F. B. ALLEN, Second Vice-President.
J. B. PIERCE, Secretary and Treasurer.

Columbia University
in the City of New York.

SCHOOL OF MINES,
SCHOOL OF CHEMISTRY,
SCHOOL OF ENGINEERING,
SCHOOL OF ARCHITECTURE,
SCHOOL OF PURE SCIENCE.

Four years' undergraduate courses and special facilities for graduate work in all departments. Circulars forwarded on application to the Secretary of the University.

E HEBER WELLS, Pattern Letters. For Iron and Brass Castings Various Sizes and Styles.... 157 William St., NEW YORK. E



This beats Wind, Steam or Horse Power.
We offer the
WEBSTER 2 1-2 ACTUAL HORSEPOWER
GAS ENGINE
For $150, less 10 per cent. discount for cash. Built on the interchangeable plan. Built of the best material. Made in lots of 100, therefore, we can make the price. Boxed for shipment, weight 800 pounds. Made for Gas or Gasoline.
Write for Special Catalog.
WEBSTER MFG. CO.
1079 W. 15th St., CHICAGO.

WE BUILD MACHINERY OR PARTS OF MACHINERY OF ANY KIND. ESTIMATES. WRITE TO JAS. P. WETHERILL MACHINE CO. CHESTER, PA.

Judge, Jury and the Opposing Counsel, admit that the Turret Lathes and Boring Mills made by The Bullard Machine Tool Company, of Bridgeport, in the State of Connecticut, are the Standard of Excellence for this kind of machinery—The case rests.

Milling Machines,

Eight Sizes, Weighing From 1000 to 4500 lbs.

DESIGNS UP-TO-DATE,
QUALITY THE BEST.

Send for information specially interesting to all Machinists and Bicycle Manufacturers.

KEMPSMITH MACHINE TOOL CO.

MILWAUKEE, WIS., U. S. A.

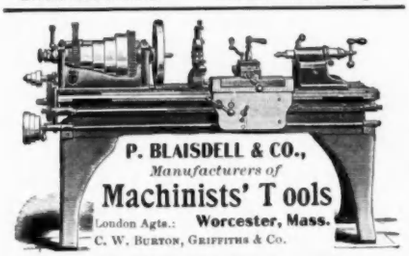
CUTTING OFF

MACHINES, the Latest and Best.

HURLBUT ROGERS MACHINE CO.,

SO. SUDBURY, MASS.

German Agents: Schuchardt & Schutte, Berlin and Vienna.
English Agents: Chas. Churchill & Co., Ltd., London and Birmingham.



SEND FOR CATALOGUE.

WORCESTER MACHINE SCREW CO

Manufacturers of Set, Cap & Machine Screws, Studs, etc.

THE WATERBURY
FARREL FOUNDRY
AND MACHINE CO.

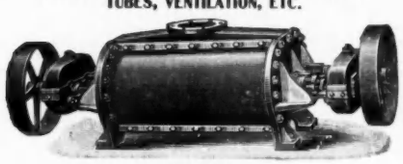
Waterbury, Conn., U. S. A.

BUILDERS OF MACHINERY FOR MAKING

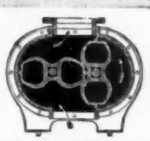
STEEL GOODS

STEEL TUBE, BICYCLE PARTS, BRASS GOODS, SILVERWARE AND HARDWARE.

ROOTS' FORCE BLAST ROTARY BLOWER.
For FOUNDRIES, SMITH SHOPS, PNEUMATIC TUBES, VENTILATION, ETC.



SLOW SPEED, POSITIVE BLAST, PERFECTLY BALANCED.



BEST MECHANICAL CONSTRUCTION.

P. H. & F. M. ROOTS, Manufacturers,
CONNERSVILLE, IND.

NEW YORK OFFICE: 109 Liberty Street.
J. B. STEWART, Manager.

In writing please mention this paper.

Buffalo FAN SYSTEM

OF HEATING & VENTILATING
ALL LARGE BUILDINGS.
BY A FORCED CIRCULATION OF WARM AIR.

CHICAGO OFFICE: 22 W. RANDOLPH ST.
NEW YORK OFFICE: 26 CORTLANDT ST.

BUFFALO FORGE CO. BUFFALO, N.Y.

ASBESTOS CEMENT FELTING,

FOR LAGGING LOCOMOTIVE BOILERS.
Samples and Descriptive Price List Free by Mail.

We are prepared to take Contracts for applying Steam Pipe and Boiler Coverings in any part of the United States.

H. W. JOHNS MANUFACTURING CO.

87 Maiden Lane, NEW YORK.

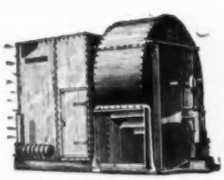
CRANES, TROLLEYS, PORTABLE HOISTS; OVERHEAD TRACK.

SEND FOR CATALOGUE.

MARIS BROS.,

2343 & 2345 Callowhill St.,
PHILADELPHIA, PA.

HEAT YOUR WORKS
BY THE
"BLOWER SYSTEM."



For Full Information and Estimates address

B. F. STURTEVANT CO.,

Boston, New York, Philadelphia, Chicago, London, Eng.

ENGINE LATHES 14" TO 30"
RADIAL DRILLS 52" TO 120"

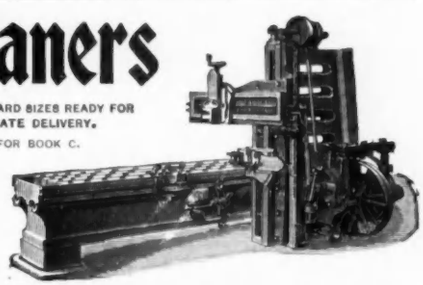
DIETZ · SCHUMACHER & BOYE

70 | 311.
72.74.76 | 313-315.
317 WEST
PLUM ST | SECOND ST

OHIO
CINCINNATI.

Open Side Planers

STANDARD SIZES READY FOR IMMEDIATE DELIVERY.
SEND FOR BOOK C.



The Detrick & Harvey Machine Co.,
BALTIMORE, MD.

18" Crank Shaper.

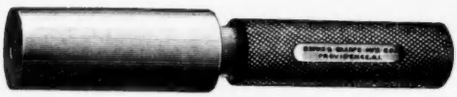
SEND FOR CATALOGUE

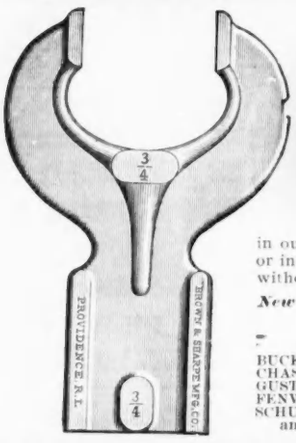
SHAPERS.

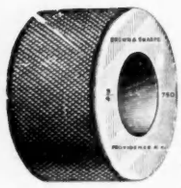
NEW FEATURES.

FLATHER PLANER COMPANY,

NASHUA, N. H., U. S. A.







BROWN & SHARPE MFG. CO.
PROVIDENCE, R. I.

Standard Gauges.

STANDARD INTERNAL AND EXTERNAL CYLINDRICAL GAUGES,
STANDARD CALIPER GAUGES,
STANDARD REFERENCE DISKS,
LIMIT GAUGES, SPECIAL GAUGES.
English or Metric Measure.

On application, we are pleased to mail price lists of Gauges and circulars suggesting the advantages of the different kinds for various classes of work. And a walk through our shops suggests that in our line few articles can be made correctly or exactly, or duplicate or interchangeable parts manufactured quickly and economically, without the use of GAUGES.

New York Office, 136 Liberty Street, Room 507.
Chicago Office and Store, 23 South Canal Street.

AGENTS.

BUCK & HICKMAN, 280 Whitechapel Road, London, E.
CHAS. CHURCHILL & CO., Ltd., London and Birmingham, England.
GUSTAV DIECHMANN & SOHN, Zimmerstrasse, 87, Berlin, S. W. 12.
FENWICK FRERES & CO., 21 Rue Martel, Paris.
SCHUCHARDT & SCHUTTE (Small Tools), 59 Spandauerstrasse, Berlin, C., and VII. Bez., Breitegasse 17, Vienna.

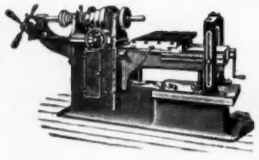
Lathes.

BUILT BY

FIFIELD TOOL CO.

LOWELL,
MASS.

PHOTOS, DESCRIPTION AND PRICE SENT ON APPLICATION.



WARNER & SWASEY,

CLEVELAND, OHIO.
MANUFACTURERS OF
HORIZONTAL
BORING MILLS.

IRON AND BRASS WORKING MACHINE TOOLS.
SEND FOR ILLUSTRATED CATALOGUE.

THE HARRINGTON & KING PERFORATING CO.

PERFORATED METALS OF EVERY DESCRIPTION FOR ALL PURPOSES

CHICAGO 227 N. UNION ST.

EASTERN OFFICE NO. 264 PEARL ST. NEW YORK

THE POND MACHINE TOOL CO.

MANUFACTURERS OF
Metal Working Machine Tools.

PLAINFIELD, N. J.

RADIAL DRILLS, BORING MILLS, PLANERS, LATHES, DRILL PRESSES, and all High Grade Tools, heavy and powerful, from latest and best designs.

MANNING, MAXWELL & MOORE,
SOLE SALES AGENTS,
111 & 113 Liberty St., New York.
424 Teleph Bldg., Pittsburgh, Pa.
60 South Canal St., Chicago, Ill.

Wanted—An Idea

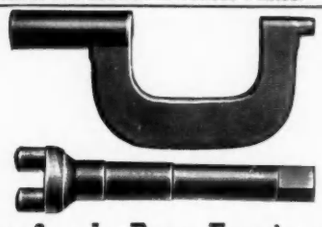
Who can think of some simple thing to patent? Protect your ideas; they may bring you wealth. Write JOHN WEDDERBURN & CO., Patent Attorneys, Washington, D. C., for their $1,800 prize offer and list of two hundred inventions wanted.

Stuart's Patent Compression Wedge Coupling.

REQUIRING NO KEYS.

Have successfully stood the test for 9 years and are still being shipped *on trial, or money returned* if you want it. All sizes kept in stock.

R. J. STUART'S FOUNDRY AND MACHINE WORKS,
NEW HAMBURGH, N. Y.



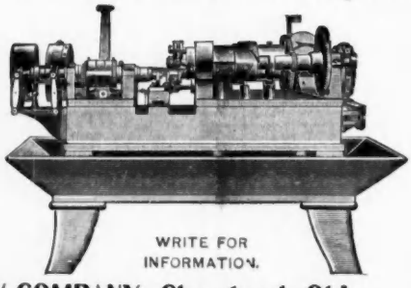
Fine Grade Drop Forgings.
WYMAN & GORDON,
WORCESTER, MASS.

TRADE MARK — NEW PROCESS STEEL BALLS

Steel Balls

WE ALSO MANUFACTURE
Automatic Screw Machines and Screw Machine Products,
ALL KINDS.

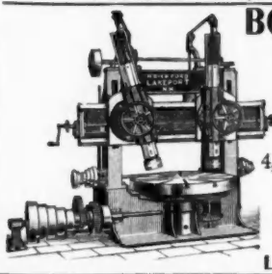
For all Anti-Friction Purposes.



WRITE FOR INFORMATION.

CLEVELAND MACHINE SCREW COMPANY, Cleveland, Ohio.

ENGLISH AGENTS—CHARLES CHURCHILL & CO., Ltd., LONDON AND BIRMINGHAM.



BORING AND TURNING MILLS,
4, 5 & 6 ft. Swing

H. BICKFORD,
LAKEPORT, N. H.

JONES & LAMSON MACHINE COMPANY, SPRINGFIELD, VT.

SEE PAGE 14.

FLAT TURRET LATHE.